NUCLEAR SCIENCE ABSTRACTS

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August 31, 1975

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ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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Volume 32, Number 4, August 31, 1975

NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

```
HOLLOWAY, J.A., Survey of image
    processing methods for
    radiography, 31:16491
HOLLWEG, J.V., Hydromagnetic waves in
    interplanetary space, 31:17953
HOLMBERG, E.B., Distribution of
    clusters of galaxies as related to
    galactic absorption, 31:18040
HOLMES, J.J., See DATES, J.F., 31:17444
```

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

```
NUCLEAR POWER PLANTS/REACTOR LICENSING
  Experience acquired in the design and construction of
    operating plants (German Federal Republic), 31:19104
NUCLEAR POWER PLANTS/REACTOR SAFETY
  Conception of radiation safety in atomic electric power
    plants, 31:19032 (CONF-701074-P1)
NUCLEAR POWER PLANTS/SITE SELECTION
  Safety-related site parameters for nuclear power plants,
    31:19052 (WASH-1361)
  Status and development of nuclear power in the Federal
    Republic of Germany, 31:19105
NUCLEAR PROPERTIES/RESEARCH PROGRAMS
  Accelerator physics group progress report, July--December
    1973 (Research summaries), 31:18544 (INS-R-139)
```

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

17606 (ANL/HEP-7440, pp I.1-I.12) ACCELERATED POLARIZED PROTONS AT THE ZGS. Ratner, L. G. (Argonne National Lab., IL). Feb 1974.
From symposium on high energy physics with polarized beams; Argonne, Illinois, USA (8 Feb 1974).
In symposium on high-energy physics with polarized beams.

is indexed as:

```
ARGONNE NATIONAL LAB., ILL. (USA)
  Accelerated polarized protons at the ZGS, 31:17606
    (ANL/HEP-7440)
  Acceleration of polarized protons in synchrotrons,
    31:17692 (ANL/HEP-7440)
  Analysis of population, birth, and death statistics in
    the counties surrounding the Big Rock Point Nuclear
    Power Station, Charlevoix County, Michigan, 31:16552
    (ANL-8149)
  Argonne polarized target facilities, 31:17762 (ANL/HEP-
    7440)
  Calculation of transient fission-gas release from oxide
    fuels, 31:19031 (ANL-8143)
```

Report Numbers

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```
WASH-
  1164          31:19026  Dep. NTIS, $16.00
  1359          31:16524  Dep. NTIS, $10.00
  1361          31:19052  Dep. NTIS, $3.75

WCAP-          (Misc.)
  7906          31:19053  Dep. NTIS, $5.50

XDC-
  68-3-68       31:18403  Dep. NTIS, $7.25

XN-            (Non-ERDA)
  74-21(Rev.1)  31:19054
  209(Suppl.4)  31:18780  Exxon, Richland, WA
  (Rev.1)

Y-
  1066          31:19188  Dep. NTIS, $4.00
```

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

8435 (AERE-Bib-189) LIST OF UNCLASSIFIED DOCUMENTS, LECTURES, ETC. BY THE STAFF OF CHEMISTRY DIVISION, AERE, HARWELL, 1 NOVEMBER 1973–31 OCTOBER 1974. Suttar, N. (comp.). (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Feb 1975. 10p. Dep. NTIS (US Sales Only) $4.00 UK 50 pence.

This list comprises unclassified material published or presented during 1974 by the staff of Chemistry Division and covers reports, memoranda, conference papers, lectures, and articles in journals. (auth)

8436 (UCRL-76859) CHEMICAL DATA ANALYSIS BY PATTERN RECOGNITION. Bender, C. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 May 1975. 20p. (CONF-750706-6). Dep. NTIS $4.00.

From conference on computer support of environmental science and analysis; Albuquerque, New Mexico, USA (9 Jul 1975).

In this paper, we present our interactive and iterative use of pattern recognition techniques to solve a number of problems, including a simple chemical example and a complicated production problem. (auth)

Analytical and Separations Chemistry

Refer also to abstract 9388.

8437 DEVELOPMENT OF CHEMICAL ANALYSIS IN 1973 (REVIEW). Pilipenko, A. T.; Volkova, A. I. Ind. Lab.; 40: No. 11, 1557-1591(Nov 1974).

Translated from Zavod. Lab.; 40: No. 11, 1297-1322(Nov 1974)

This review is a continuation of the previous ones and has the same restrictions on the choice of material used. New data published in 1973 on methods and instruments used in the analysis of inorganic materials are given in Table 1 and the text. The review covers: extraction; new organic reagents and methods of analysis; concentration of microimpurities; ion-exchange and chromatography methods; substance phase analysis; electrochemical methods; atomic-absorption and spectral methods of analysis; x-ray spectral and x-ray flourescence methods of analysis; mass spectrometry, infrared spectroscopy, and NMR methods; neutron activation and radiometric methods; and other methods and problems of analytical chemistry. (313 references) (LK)

8438 THORIUM IN COMMERCIALLY AVAILABLE RARE EARTH COMPOUNDS. McMillan, R. C.; Horner, H. E.; Horne, S. A. (Army Mobility Equipment Research and Development Center, Fort Belvoir, VA). Health Phys.; 28: No. 5, 628-630 (May 1975).

The results of analyses for thorium and uranium carried out on rare earth compounds obtained from chemistry laboratories and glass polishing operations are reported. Thorium concentrations up to 10 times the defined "unimportant quantity" were found. The containers for these materials had no indication that thorium was present. It is possible that many other laboratories have these compounds and are unaware of the potential radiations. Suppliers should label such compounds to assist the users in complying with regulations and prevent unnecessary exposure. (UK)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 9266 and 9296.

8439 (AD/A-000112) EXPERIMENTAL METHODS OF ATMOSPHERIC AEROSOL RESEARCH. I. Methods of Sample Collection and Analysis. Surikov, O. M. Translated from Probl. Fiz. Atmos.; No. 6, 63-67(1968). 23p. (FTD-HC-23-2117-74). NTIS $3.25.

Methods of sampling and analysis of atmospheric aerosols are discussed. Thermal, gravitational, electrostatic, and inertial precipitation and filters are briefly described. Optical and electron microscopy and neutron activation analysis for determining chemical properties are also discussed. (GRA)

8440 (LA-UR-75-1013) NONDESTRUCTIVE ASSAY OF INVENTORY VERIFICATION SAMPLES AT THE LASL VAN DE GRAAFF SMALL-SAMPLE ASSAY STATION. Evans, A. E.; Malanify, J. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 19p. (CONF-750608-4). Dep. NTIS $4.00.

From annual meeting of the institute of nuclear materials management; New Orleans, Louisiana, USA (18 Jun 1975).

Small samples are assayed for fissile content by cyclically bombarding them with 300 to 500-keV neutron pulses and counting between pulses delayed neutrons from fission. Neutron absorption in the sample, with resultant response nonlinearity, is minimized by shielding the sample from thermal and resonance-region neutrons with cadmium and B_4C. A production small-sample assay system has been built using the above principle. Biases of the order of 1 to 2 percent can occur in the assay of samples in this system, due to gross differences in makeup between assay samples and calibration standards. These biases are minimized or removed by matching standards and samples and by measurement of the effect of sample parameters on the assay response. Typical parameters studied and their effects are: fissile quantity (+0.077 percent/g fissile), inert dilution (up to 2 percent in a 5-cm^3 vial), sample height (1 percent over a range of 25 mm), hydrogen content (+0.1 percent/mg of H), and thorium content (+0.12 percent/g of Th). Assay precision as good as 0.34 percent (1 sigma) has been achieved. (auth)

8441 (RNF-1-74) APPLICATION OF ACTIVATION ANALYSIS ON ROCK SAMPLES. Ozyol, H.; Barutcugil, E.; Dincer, S. (Ankara Nuklear Arastirma Merkezi (Turkey)). Feb 1974. 12p. (In Turkish). INIS.

Si, Al, and Fe in rock samples were determined by the use of fast neutron activation analysis. The stripping of the complex gamma spectra resulting from samples irradiated by 14-MeV neutrons was performed in two steps. First the effect of other elements with short half-lives was eliminated and then a graphical stripping method was applied. Suitable standards were used for quantitative analysis. (auth)

8442 PRESENT STATE AND PROSPECTS OF REACTOR ACTIVATION SPECTROMETRY. Simonits, A. (MTA Kozponti Fizikai Kutato Intezete, Budapest); Bereznai, T. Izotoptechnika; 18: No. 2, 49-63(Feb 1975). (In Hungarian).

The subject is reviewed (49 references, mostly English-language), with discussions on such subjects as reactor neutron energies, measurement methods, gamma-spectrum examination, and limits of detection. (TTT)

8443 SMALL COMPUTERS INACTIVATION ANALYSIS. Bodizs, D. (Muszaki Egyetem Tanreaktora, Budapest); Keomley, G.; Pernecki, G. Izotoptechnika.; 18: No. 3, 132-137(Mar 1975). (In Hungarian).

8444 IN VIVO NEUTRON ACTIVATION ANALYSIS OF NITROGEN USING CAPTURE GAMMA RAYS. Ettinger, K. V.; Biggin, H. C.; Chen, N. S.; Chettle, D. R.; Fremlin, J. H.; Harvey, T. C.; Morgan, W. D.; Nowotny, R.; Thomas, B. J.; Vartsky, D. (Birmingham Univ. (UK). Dept. of Physics. Kerntechnik; 17: No. 2, 89-92(Feb 1975).

The work described is an application of neutron capture gamma spectroscopy to the field of in vivo neutron activation analysis. Central to the technique is the pulsing of the neutron beam linked to the collection of data in a pulsed mode. The pulsing regime established for the observation of the gamma rays from the reaction $^{14}N(n, \gamma)^{15}N$ is discussed, as is the dosimetry developed for the use of this technique in the measurement of nitrogen in the clinical situation. (auth)

8445 DETERMINATION OF POTASSIUM–ARGON AGES OF MINERALS AND ROCKS BY NEUTRON ACTIVATION ANALYSIS OF ARGON. Geochimica (Engl. Transl.); 1: No. 1, 50-57 (1973).

Translated from Ti Ch'iu Hua-hsueh; 1: No. 1, 51-58(1973).

In order to improve the sensitivity and precision of the K–Ar age-dating method, Ar was measured in minerals and rocks by neutron activation and compared with the results obtained by other methods. The results indicate that the experimental procedures and apparatus used are reliable and that radiogenic Ar is detectable at 5×10^{-9} g. Because retention of radiogenic Ar in limestone is poor, K–Ar ages of limestones tend to be very low. The errors at each stage of the measurements are indicated. (JSR)

8446 STUDY OF LEAD DISTRIBUTION IN HUMAN TEETH, USING CHARGED PARTICLE ACTIVATION ANALYSIS. Malik, S. R.; Fremlin, J. H. (Univ. of Birmingham, Eng.). Caries Res.; 8: 283-292(1974).

A technique is described by which the distribution of lead and the lead content in human teeth has been measured by means of $^{3}He^{2+}$ activation analysis. The α-activities of samples and of standards containing known amounts of lead have been recorded on a cellulose acetate plastic film which is insensitive to β-particles, γ-rays, or light. The plastic film is then etched and scanned in an optical microscope. The lead content is found to vary, showing higher concentration at the exterior of the enamel and at the amelodentinal junction. The lead content is found to increase at higher age groups (>25 years), showing a tendency for a peak of lead concentration to form with age near the pulpal surface. The implications of these results are discussed. (auth)

8447 HOW MUCH SILVER IN YOUR SHILLING. Malati, M. A.; Mazza, R. J. (Medway and Maidstone Coll. of Tech., Chatham, Eng.). Educ. Chem.; 12: No. 3, 85-87(May 1975).

The principles of neutron activation analysis are explained, and experimental details are given of a simple application of the method to the activation of silver in a shilling coin by slow neutrons. (UK)

8448 DETERMINATION OF OXYGEN IN STEEL BY FAST NEUTRON ACTIVATION ANALYSIS. Dincer, S.; Ozyol, H.; Sevimli, H.; Barutcugil, E. (Ankara Nuklear Arastirma Merkezi (Turkey)). Tech. J. Ankara Nucl. Res. Cent.; 1: No. 3, 111-120 (Oct 1974).

The oxygen content of steel samples was determined using the ^{16}O (n,p)^{16}N reaction produced by the interaction of 14-MeV neutrons. A pneumatic transfer system allowing the rapid transfer of the irradiated samples to the counting position was used due to the short half-life of the product ^{16}N isotope. Mylar films placed inside a steel cylinder were used as standards for the quantitative analysis. Consequently, the oxygen amounts in eleven different samples were found to be between 11 ± 4 ppM and 1243 ± 95 ppM. (INIS)

8449 EXCITATION FUNCTIONS FOR CHARGED-PARTICLE-INDUCED NUCLEAR REACTIONS IN LIGHT ELEMENTS AT LOW PROJECTILE ENERGIES. Lorenzen, J.; Brune, D. (Aktiebolaget Atomenergi, Studsvik (Sweden)). pp 325-473 of Handbook on Nuclear Activation Cross-Sections. Neutron, Photon and Charged-Particle Nuclear Reaction Cross-Section Data. Vienna; IAEA (1974).

This compilation of data should be useful in various fields of nuclear applications, with emphasis on charge-particle activation analysis. Activation analysis of light elements using charged particles has proved to be an important tool in solving various problems in analytical chemistry, e.g., those associated with metal surfaces. Scientists desiring to evaluate the distribution of light elements on the surface of various matrices using charged-particle reactions require accurate data on cross-sections in the MeV-region. Also, a knowledge of cross-section data and yield functions is of great interest in many applied investigations involving work with charged particles, such as radiological protection and health physics, material research, semiconductor material investigations and corrosion chemistry. A limited number of data of use in these fields was collected. Although the compilation is far from being complete, it is expected to be of assistance in devising measurements of charged-particle reactions in Van de Graaff or other low-energy accelerators. (auth)

8450 DETERMINATION OF IMPURITIES IN SEMICONDUCTOR GRADE SILICON BY THE NEUTRON ACTIVATION METHOD. Zmijewska, W. (Institute of Nuclear Research, Warsaw (Poland)). Chem. Anal. (Warsaw); 18: 817-823(1973). (In Polish).

Determinations of Ag, Cr, In, and Fe in semiconductor-grade silicon were carried out. Activity measurements were performed by means of a gamma scintillation spectrometer after radiochemical separation of the elements to be determined. The lower limit of the determination amounted to ~1 ng for Ag and In, to 5 ng for Cr, and to 50 ng for Fe. (auth)

Chemical and Spectral Procedures

8451 (BNWL-CC-2396) 2AF SODIUM NITRITE MONITOR: INTERIM REPORT. Dierks, R. D.; Russell, J. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1970. Contract AT(45-1)-1830. 15p. Dep. NTIS $4.00.

The feasibility of monitoring the sodium nitrite in the 2AF makeup tank in the Purex process by measuring the NO_2 concentration of the gas phase was investigated in simulation studies. It was concluded that the NO_2 concentration is a function of the nitrite concentration but is also dependent on the sample temperature, acid concentration of the sample, and air/liquid ratio maintained in the simulated conditions. However under proper conditions of constant air purging, the NO_2 content can be related to the nitrite concentration. (JSR)

8452 (LA-5884) DETERMINATION OF COMBINED SULFUR IN NUCLEAR REACTOR FUEL MATERIALS. Thorn, L. E.; Bryan, R. G.; Waterbury, G. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1975. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

Combined sulfur is measured spectrophotometrically as the ethylene blue complex after separation from uranium and plutonium by hydrogen sulfide distillation. Higher sulfur oxidation states are reduced by a mixture of hydriodic acid, sodium phosphite, and acetic acid to hydrogen sulfide that is distilled into a zinc acetate solution. The acidic color reagent, NN-diethyl-p-phenylenediamine (DEPD), and ferric chloride react with zinc sulfide to form ethylene blue whose absorbance is measured at 675 nm after 15 min. Only those ions that interfere with the reduction or precipitate as highly insoluble sulfides cause interference in this method. The relative standard deviation is 10 to 1 percent for 2 to 30 mu g of sulfate sulfur in samples containing up to 400 mu g of uranium and plutonium. (auth)

8453 (N-75-10194) QUANTITATIVE DETERMINATION OF BENZO/A/PYRENE IN TAR-CONTAINING DRUGS BY AN ISOTOPE DILUTION METHOD. Masuda, Y.; Shimamura, K.; Kagawa, R. Translated from Jap. Anal.; 22: No. 11, 1424-1427(11 Nov 1973). 12p. (NASA-TT-F-15983).

Studies were made of a method of quantitative determination of the benzo/a/pyrene contained in tar-containing drugs by an isotope dilution method using tritiumized benzo/a/pyrene. Analytical procedures were performed in the following sequence: liquid phase distribution extraction method, dual-layer, one-dimensional thin layer chromatography, and ultraviolet absorption spectral analysis. The rate of recovery obtained at this time varied between 30% and 80%, with a fluctuation coefficient of 15-30%. If this were corrected by the recovery ratio, the amount of benzo/a/pyrene in the sample was found in a state close to 100%, and the fluctuation coefficient was reduced to 4-9%. Even in cases when benzo/a/pyrene is not detected in a sample, its ascertainable limit can be found easily. The benzo/a/pyrene contents in pine tar, Pityrol pasta, Glyteer, and Ichtammol were 9.72, 1.32, 12.90, and less than 0.05 ppm, respectively. (auth)

8454 DETERMINING TRACES OF ELEMENTS BY ATOMIC EMISSION AND ABSORPTION FLAME SPECTROPHOTOMETRY. Prudnikov, E. D. Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 18: No. 2, 186-189(1975). (In Russian).

Because of the low absolute limits of detection it is possible to determine directly in various materials a large number of microelements at a level of 10^{-5} to 10^{-7}% and lower. The required weight

of sample is 1 to 10 mg, and the accuracy of the analysis is on the order of 10%. Absolute limits of detection by atomic emission are tabulated for the elements: Na, K, Li, Rb, Cs, Ca, Sr, Ba, Al, Ga, In, Tl, Sm, Eu, Ho, Er, Yb, Cr, Mn, Fe, Ni and Cd. Absolute limits of detection by atomic absorption are given for the following elements: Zn, Ag, Pb, Bi, Co, Hg, Cu, Se, Te, As, Sb and Sn. (SJR)

8455 DETERMINATION OF Mo(VI) IN WATER-ORGANIC SOLVENTS BY ANODIC STRIPPING VOLTAMETRY. Sagradyan, S. I.; Agasyan, P. K.; Nikolaeva, E. R. Vestn. Mosk. Univ., Ser. II. Khim.; 16: No. 1, 67-69(1975). (In Russian).

The electrochemical behavior of Mo(VI) on solid electrodes in 0.1 M $LiClO_4$ water–organic solutions has been studied. The wave of the Mo(VI) reduction was detected in the acetonitrile and dimethylsulfoxide–water solutions (9:1), the height of the peak being proportional to the Mo(VI) concentration. (auth)

8456 APPLICATION OF QUADRUPOLE MASS SPECTROMETRY TO NITROGEN ISOTOPE ANALYSIS. Green, L. A. Urbana, IL; Univ. of Illinois (1974). 97p. University Microfilms Order No. 75-11,577.

Thesis (Ph. D.).

Mass spectrometry is the primary tool employed for isotopic analysis. To alleviate many of the problems encountered with magnetic instruments, the use of a quadrupole mass spectrometer is proposed. A total system for performing routine nitrogen isotopic analysis is presented in this thesis. The system allows for a high ratio of analytic gas to residual gas for analysis. Linearity of spectral sweep is improved so averaged spectra can be integrated to improve accuracy of ratio. Accuracy and precision of better than 0.2 percent have been obtained. The major differences between magnetic and dynamic mass spectrometers are discussed with regard to the practical significance of these differences. The theory of the quadrupole mass spectrometer is reviewed and discussed in relationship to the variations in design parameters, the physical effects encountered, and the trade-offs that are encountered in the final system design. The construction and operation of a quadrupole mass spectrometer and associated systems are described. The chemical systems required for analysis are presented and evaluated, in respect to methods of analysis. The results of analyses are presented to show the accuracy and precision obtainable with this system. Precision of the data is examined with respect to the number of mass spectra averaged, the number of points integrated, and the rate at which the data are acquired. Finally several suggestions are brought forth in which the quadrupole mass spectrometer may prove itself to be a valuable research tool. (Diss. Abstr. Int., B)

8457 SPECTROPHOTOMETRIC DETERMINATION OF Mo WITH PENTAOXIBENZOPHENONE. Popa, G.; Dumitrescu, V.; Dumitrescu, N.; Vegh, B. Rev. Chim. (Bucharest); 26: No. 2, 160-163(Feb 1975). (In Rumanian).

The reaction of Mo(VI) with pentaoxibenzophenone in slightly acid medium, pH = 5.6 has been spectrophotometrically studied. On the basis of this study, a spectrophotometric method for Mo(VI) determination in concentration limits of 0.2–16μg Mo(VI)/cm^3 has been worked out. The molar absorption coefficient being of 15,800 1 $mol^{-1}cm^{-1}$. The reaction of Mo(VI) with pentaoxibenzophenone in the presence of hydroxylamine hydrochlorate has also been studied. At a pH = 4.6 and a wavelength of 410 nm, the molar absorption coefficient was about 9,960 1 $mol^{-1}cm^{-1}$. Molybdenum was determined with this reactant in a ferromolybdenum alloy after separating the iron by extraction. The determination error did not exceed 3%. (auth)

8458 SPECTROGRAPHIC DETERMINATION OF RHENIUM IN URANIUM ORES. Dabrowska, J.; Fijalkowski, J. (Inst. of Nuclear Research, Warsaw). Chem. Anal. (Warsaw); 19: No. 1, 153-159(1974). (In Polish).

The determination of 0·3 p.p.m. of Re in the presence of up to 0·2% of Mn and 0.1% of Mo is possible if 5% of CuO is added to the sample of the ore (20 mg). For samples containing 0.3 to 3 p.p.m. of Re, use of the Re 3460.46-Å line vs. the background emission at 3460.0Å is preferred, the relative error being ±50%. For higher contents of Re, the Re 3464.75-Å line can be used, the error being much smaller. Graphite electrodes were employed, the lower one (the anode) having a crater to hold the sample pellet; to avoid interference by Mn the exposure time should be 15 sec., with a 9-amp. d.c. arc. The anode dimensions are shown in a diagram. (Anal. Abstr.)

8459 USE OF A UHF DISCHARGE IN THE ATOMIC-ABSORPTION DETERMINATION OF BARIUM, STRONTIUM, AND CALCIUM IN DEPOSITS (CONDENSATES). Bachurina, L. G.; Perminova, V. M.; Savostin, S. A. Ind. Lab.; 40: No. 11, 1620-1622(Nov 1974).

Translated from Zavod. Lab.; 40: No. 11, 1348-1351(Nov 1974).

A UHF plasma discharge together with emission and absorption methods of analysis were used to determine small quantities of barium, strontium, and calcium in deposits in their mutual presence. Since the intensity of the spectral lines depends mainly on the atomic concentrations of the elements, the temperature, and the excitation potential, while the degree of absorption is determined by the concentration of the atomic vapor and the length of the absorbing column, the manner in which they varied with the amounts potassium and ethanol in sprayed solutions was studied. The effect of the atmosphere (argon and air) and the power of the discharge on the line intensities was also considered. (LK)

8460 USE OF FLAME PHOTOMETRY FOR THE DETERMINATION OF SMALL QUANTITIES OF RUBIDIUM IN BASIC AND ULTRABASIC ROCKS. Yakovleva, S. Z.; Sheinina, G. A. pp 214-221 of Geokhimiya radiogennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

The possibility of determining trace quantities of Rb by flame photometry was studied. The effect of Ca, Mg, Al, Fe, K, and Na on the emission of Rb was determined. An evaluation was made of the sensitivity, precision (reproducibility), and accuracy of the analysis. It was shown that the flame photometric method used for the determination of Rb is satisfactory for the majority of geochemical problems. (tr-auth)

8461 MASS DISCRIMINATION IN SOLID-PHASE ION SOURCES FOR A MASS SPECTROMETER. Samsonov, S. P. pp 221-227 of Geokhimiya radiogennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

The factors causing mass discrimination in solid phase ion sources for a mass spectrometer are examined. The requirements on the construction of ion sources with surface ionization and on the method of isotopic analysis are discussed. The factors which will minimize and stabilize the mass discrimination in ion sources and will substantially improve the reproducibility of the measurement of the isotopic ratio of Rb and Sr are discussed. (tr-auth)

8462 MODERNIZATION OF THE MI-1305 MASS SPECTROMETER FOR PRECISION ISOTOPIC ANALYSIS OF RUBIDIUM AND STRONTIUM. Samsonov, S. P.; Gorokhov, I. M.; Kutyavin, E. P. pp 228-240 of Geokhimiya radiogennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

The reasons that the MI-1305 mass spectrometer could not give the precision in isotopic ratio measurements required in contemporary geochronology and geochemistry were discussed. The improvements made in the analytical and measurement parts of the mass spectrometer are described. Some control methods that significantly improve the number of measurements and increase the efficiency of the isotopic analysis are discussed. (tr-auth)

8463 ISOTOPIC COMPOSITION OF RUBIDIUM AND STRONTIUM IN REFERENCE SALTS. Samsonov, S. P.; Kutyavin, E. P.; Gorokhov, I. M. pp 240-249 of Geokhimiya radiogennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

The methods and results obtained in the measurement of the isotopic composition of Rb and Sr in some reference salts are described. A solution of rubidium sulfate was used for the sample of reference Rb and the interlaboratory standard of the Massachusetts Institute of Technology was used for the Sr. The measurements were made on the modernized MI-1305 mass spectrometer. During the processing of the measurement data different types of corrections were introduced and the normalization procedure was used. The results obtained were tested by a two-stage dispersion analysis in order to establish the contribution of dispersion processes occurring in the different elements of the mass spectrometer to the total measurement error. It was shown that the internal error in the measurement of the isotopic composition of Rb and Sr did not exceed 0.06% (coefficient of variation) and the reproducibility of the measurements is 0.12 to 0.19% for Rb isotopic ratios and unnormalized Sr ratio and 0.22% for normalized $^{87}Sr/^{86}Sr$ ratios. (tr-auth)

8464 URANIUM-SENSITIVE ELECTRODE MEMBRANE. Dietrich, W. C.; Manning, D. L. (to U. S. Atomic Energy Commission). US Patent 3,864,233. G01n27/46. 4 Feb 1975. Filed date 17 Dec 1973. 5p.

PAT-APPL-425,415.

A uranyl sensitive membrane, useful in an electrochemical concentration cell, comprising a uranyl complex of an organophosphoric acid embedded within a polyvinyl chloride matrix is described. (auth)

8465 MICRO-DETERMINATION OF IODINE IN WATER. Garcia Jeronimo, R. A. R. (Univ. Nacional del Sur, Bahia Blanca, Argentina). Rev. Asoc. Bioquim. Argent.; 38: No. 207-208, 139-144(1973). (In Spanish).

The sample (3·5 or 0·5 ml, for iodine contents ⟨0·16 or⟩ 0·15 mg per litre, respectively) is diluted to 4 ml with H_2O and 5 ml of 20% HCl–20% H_2SO_4 mixture is added. Then, 4 ml of this soln. is added to 0·5 ml of 0·1N–$NaAsO_2$ followed by 1 ml of 0·02N-2 $(NH_4)_2SO_4 \cdot Ce(SO_4)_2$. After a measured time (dependent on temp., and obtained from a graph) the extinction is measured at 425 nm. A series of standards is measured with each determination. Ions reacting with iodine or reducing the Ce^{IV} interfere. The precision is ±4.2% or ±1.64% for the low or high range, respectively. (Anal. Abstr.)

8466 DETERMINATION OF SMALL ADMIXTURES OF ^{131}I IN ^{99}Mo. Stephan, H.; Thieme, K. Isotopenpraxis; 11: No. 3, 105-106(Mar 1975). (In German).

A method to determine small admixtures of ^{131}I in ^{99}Mo is presented. Owing to the fact that the decay schemes of both nuclides are well known, peak evaluation is possible though energy lines cannot be separated the spectrometric way. The method supplies sufficient accuracy with admixtures ranging up to 0.05%. (auth)

8467 PHENOTHIAZINE DERIVATIVES AS NEW REAGENTS IN QUANTITATIVE ANALYSIS. Part 3. Extractive–Colorimetric Method of Determination of Molybdenum by Means of Chloropromazine, Methopromazine and Diethazine. Tarasiewicz, M.; Puzanowska-Tarasiewicz, H. (Wyzsza Szkola Inzynierska, Bialystok (Poland)). Chem. Anal. (Warsaw); 18: 599-607(1973). (In Polish).

Phenothiazine derivatives (PE): chloropromazine, methopromazine and diethazine react in an acid medium with thiocyanate complexes of molybdenum(V) forming orange colored compounds, sparingly soluble in water, of the following formula: (PF · H) $[MoO(SCN)_4]$. The quantitative extraction of these compounds has been advantageously used for elaboration of an extractive-colorimetric method of molybdenum determination. The method consists in chloroform extraction of the above mentioned compounds from aqueous medium ($C_{H_2SO_4}$ = 2.0 N, C_{NH_4SCN} = 1.5 M) and absorbance measurement at λ = 465 nm. The Beer's law is valid at the concentrations ranging from 1 to 10 μg Mo/cm³. The time of analysis amounts to approximately 20 minutes. In the determination, Co(II), Cu(II), Bi(III), Fe(III), Ti(IV), W(V), U(VI) interfere. (auth)

8468 APPLICATION OF TRI-N-BUTYL PHOSPHATE AND THIOCYANATE IONS TO MOLYBDENUM DETERMINATION. Rozycki, C.; Kaminska, J. (Politechnika Warszawska (Poland)). Chem. Anal. (Warsaw); 18: 777-780(1973). (In Polish).

A method of colorimetric determination of molybdenum has been devised. It consists in extraction of thiocyanate complex of molybdenum with 15% solution of TBP in $CHCl_3$. The method is not disturbed by iron (30 mg), tungsten (1.5 mg), nickel (15 mg), manganese (15 mg), zinc (15 mg), chromium(III) (15 mg), cobalt (15 mg), vanadium(V) (10 mg) and titanium (0.2 mg). But it is disturbed by niobium, though its influence may be eliminated by measuring absorption at 390 and 470 nm and solving a system of equations with two unknowns. To perform the determination: to the molybdenum solution (ab. 20 μg Mo) in a separating funnal of 25-ml capacity 1.5 nl of 9 M HCl, 3.0 nl of 3 M KSCN, 3 nl of 20% ascorbic acid, 0.1 ml of 4% solution of $CuSO_4$ in 0.36 N H_2SO_4 are added and filled up to 7.5 nl with water. After 5 min, 5nl of 15% TBP in $CHCl_3$ is added, and extracted for 30 sec. When phases are separated, the organic phase is transferred to a measuring flask of 10-nl capacity, filled with chloroform to the mark and absorbancy is measured (after 10–15 min) at 390 and 470 nm in respect to the blank. (auth)

8469 SPECTROPHOTOMETRIC STUDIES ON MOLYBDENUM (VI) REACTION WITH HYDROXYLAMINE AND 4-(THIAZOLYLAZO) RESORCINOL (TAR). Determination of Molybdenum. Szczygielska, M.; Kasiura, K. (Politechnika Warszawska (Poland)). Chem. Anal. (Warsaw); 18: 799-806(1973). (In Polish).

In presence of hydroxylamine molybdenum(VI) forms with TAR a complex of Mo : TAR = 1 : 1 composition. The optimum range pH 4.5–5.7, molar absorption coefficient of the complex amounts to 2.94×10^4 at 530 nm, and its conditional stability constant 4.4×10^5. The method devised for the determination of molybdenum in copper ores was carried out after the initial separation with α-benzoinoxime in sodium tungstate. (auth)

8470 APPLICATION OF THIOCYANATE IONS FOR DETERMINATION OF THORIUM. Part 1. Complexometric Determination after Tri-n-Butyl Phosphate Extraction. Rozycki, C. (Politechnika Warszawska (Poland)). Chem. Anal. (Warsaw); 18: 145-150(1973). (In Polish).

Investigations have been carried out extraction of thiocyanate complexes of thorium in dependence on concentration of TBP in CCl_4, and of thiocyanate and hydrogen ions in aqueous phase. Conditions of quantitative extraction of thorium have been chosen on this basis. Under optimum conditions the influence of other metals on thorium extraction and its complexometric determination has been studied. It has been established that nickel, cadmium, cobalt, zinc, aluminium, iron, lanthanum, copper, uranium, bismuth and magnesium do not hinder the determination of thorium in contrast to gallium, indium and zirconium. The method elaborated for thorium determination consists in a double extraction from 3.6 M solution of KSCN (pH 1.5–2.5, volume 25 ml) with 5 ml of 10% TBP solution in CCl_4. The organic phase is then reextracted with a solution containing 10 ml of 9 M KSCN and 1 ml of 0.1 M HNO_3 Then thorium is determined in the organic phase by titration with disodium EDTA after adding 50 ml of 0.01 M HNO_3 and xylenol orange as indicator. (auth)

8471 COLORIMETRIC DETERMINATION OF MOLYBDENUM AND TITANIUM IN CHLOROPLATINIC ACID. Rozycki, C.; Suszczewski, W. (Politechnika Warszawska (Poland)). Chem. Anal. (Warsaw); 18: 621-624(1973). (In Polish).

Molybdenum and titanium are separated from a solution of chloroplatinic acid by precipitating them with 5 mg of Al in presence of 5 mg of Pb at pH 5.4–5.5. The precipitation is carried out from solutions 0.25 M in respect to sodium nitrate (coagulates the sediment) with a diluted solution of sodium hydroxide. The precipitate obtained is dissolved in 5 ml of hydrochloric acid (2 + 3). After adding 3 ml of 20 percent solution of ascorbic acid, 2 ml of 6 M KSCN and 0.1 ml of 0.04 percent $CuSO_4$ the thiocyanate complex of molybdenum is extracted with 5 ml of 15 percent TBP in $CHCl_3$. The organic phase is diluted with chloroform up to 10 ml and absorption is measured at 470 nm. After the extraction of molybdenum to the aqueous phase 0 5 ml of concentrated HCl and 0.2 g of NaI are added. After 10 minutes platinum is extracted (it may be coprecipitated with Mo and Ti and it hinders the determination of Ti) with 10 ml of 15 percent TBP in hexane. To the aqueous phase obtained there are added 2.5 ml of 6 M KSCN, 2.5 ml of 5 percent diantipyryl solution in 2 M HCl and 1 ml of 10 percent stannous chloride in 2 M HCl. Titanium is then extracted twice with 5 ml of $CHCl_3$. Combined organic phases are diluted up to 25 ml with chloroform and absorption measured at 420 nm. This method was used to determine 9.8×10^{-4}% Mo and 1.0×10^{-3}% Ti in a chloroplatinic acid solution (titanium was added in form of the standard). Standard deviation for Mo amounted to 0.8×10^{-4}%, while that for Ti–0.5×10^{-5} percent. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 8948, 8972, 9001, 9013, 9218, 9303, and 9612.

8472 (BNWL-1950(Pt. 1), pp 66-67) RADIOANALYTICAL TECHNIQUES FOR ^{241}Am AND ^{244}Cm DETERMINATIONS IN BIOLOGICAL SAMPLES. Powers, G. J. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I, Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The methods of liquid scintillation counting and alpha energy analysis are discussed. (MCG)

8473 (CONF-730571-) COLLOQUIUM ON X RAYS AND MATTER, MONTE CARLO, MONACO, MAY 22–26, 1973. (Siemens S. A.; 92 - Saint-Denis (France). Service Instrumentation Scientifique). 1973. 416p. (In French).

Forty-three papers are presented on the applications, mainly analytical, of x rays in matter: x-ray diffraction, crystal structures, texture, petrography, high-temperature structures, x-ray emission and fluorescence, instrumentation and automation, etc. Separate abstracts were prepared for four papers dealing with the localized proportional counter, a Si(Li) detector, ThO_2–Ln_2O_3 systems, and analysis of Ce in steels. Two other papers were previously abstracted; see NSA 29:5529 and 29:16240. (DLC)

For abstracts of individual papers see: 8474, 8971–8972, and 9327.

8474 (CONF-730571-, pp 345-351) METHOD FOR THE DIRECT ANALYSIS OF CERIUM IN STEELS BY X-RAY SPECTROMETRY. Alota, S.; Bartoli, P. (Centro Sperimentale Metallurgico, Rome). 1973. (In French).

From colloquium on x rays and matter; Monte Carlo, Monaco (22 May 1973).

In colloquium on x rays and matter, Monte Carlo, Monaco, May 22–26, 1973.

A direct method for the calculation of the Ce content in steels was developed based on a spectrometric study of the fluorescence x rays. Because of the impossibility of having steel samples with a certified Ce content, it was necessary to develop a preliminary calibration by means of a solution method using syn-

thetic samples and then to evaluate from the calibration curve the Ce contents of several industrial samples. A calibration curve by the method of direct analysis was then obtained. It was verified that the analysis of NBS cast iron samples having certified contents follow the same calibration. It was then concluded that there was no interference from the matrix and therefore it is legitimate to think that this calibration curve can be validly used for other types of steel, even stainless steel. Reproducibility and accuracy were determined; variation coefficients are less than 1.5%. (tr-auth)

8475 (UCRL-76418) STATUS OF PLUTONIUM ISOTOPIC MEASUREMENTS BY GAMMA-RAY SPECTROMETRY. Gunnink, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Jun 1975. 29p. (CONF-750607-14). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A nondestructive method for determining plutonium isotopic abundance ratios, based on the detection and measurement of the gamma rays emitted, is now being accepted as routine for solution samples. The analysis of solid samples is of more general interest, but more difficult to achieve. One major problem is the nonuniform packaging and inhomogeneity of these samples. This results in calibration difficulties because of the uncertainties in the gamma-ray attenuations. One way of minimizing these experimental problems is to select one or more sets of neighboring peaks in the spectrum whose components are due to the different isotopes and to accurately measure the observed peak intensities. Since the detection efficiencies are nearly the same for adjacent peaks, the isotopic ratios are largely dependent on the branching intensities, the half-lives and the observed peak intensities. There are eight groups in a typical plutonium spectrum that potentially can yield information on isotopic ratios. A computer program was written to assess the potential of each grouping. The findings of this study and some of the problems associated with the various peak groupings are discussed. The 100-keV grouping was selected for additional study. Preliminary experimental results indicate that isotopic ratios of 1 percent and better can be obtained using this multiplet of peaks. (auth)

8476 SYSTEM FOR ENRICHMENT AND LIQUID SCINTILLATION COUNTING OF LOW LEVEL TRITIUM IN WATER. Florkowski, T.; Grabczak, J. (Inst. of Nuclear Physics and Techniques, Krakow). Nukleonika; 20: No. 3, 273-280(1975).

Analytical method for measurement of natural tritium in water samples is described. The method adapted consists of electrolytic enrichment and liquid scintillation counting. A set of 20 steel cells is used for routine enrichment. Tests of reproducibility and possibility of contamination results in analytical accuracy of ±4% and minimum detectable tritium content of 3 T. U. Insta-gel and dioxane based scintillators are used for water samples counting in a TRICARB spectrometer. (auth)

8477 SEPARATION OF EMANATION FROM MINERALS AND ORES BY THE USE OF ULTRASONIC VIBRATIONS. Gorbushina, L. V.; Laubenbakh, E. A.; Semenov, V.Yu. (Moscow Geological Inst.). Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 2, 117-122 (Feb 1975). (In Russian).

Samples of zircon, monazite, uraninite and other radioactive minerals (<10 g) were analyzed for radon in the usual fashion. It is shown that by the use of ultrasonic vibrations it is possible to extract additional amounts of radon from the sample which cannot otherwise be separated. The optimum treatment time with ultrasonic vibrations was 20 min. Apparently crack formation is promoted by the ultrasonic vibrations so that additional radon can be liberated and counted as a radioactive gas on a scintillation counter. (SJR)

8478 GROUP DETERMINATION OF RUBIDIUM, STRONTIUM, YTTRIUM ZIRCONIUM, AND NIOBIUM IN ROCKS BY AN X-RAY RADIOMETRIC METHOD. Zaitsev, E. I.; Kurochkin, S. S.; Dneprovskii, I. S.; Margolin, E. M. (Inst. of the Mineralogy, Geochemistry, and Crystal Chemistry of Rare Elements, Moscow). Ind. Lab.; 40: No. 11, 1611-1614(Nov 1974).

Translated from Zavod. Lab.; 40: No. 11, 1339-1343(Nov 1974).

A study was made of the possibility of a group determination of the elements from Rb to Nb and Cs to Ce in rocks on exciting their x-ray spectra by the photon emission of the ^{170}Tm isotope and recording them with a Si(Li) detector. The results confirmed the possibility of making a group analysis of many-component samples with a sensitivity threshold of 1×10^{-3}% . The relative error of the analysis was 20-30% for $n \times 10^{-3}$% of the elements under determination, 10-15% for $n \times 10^{-2}$%, and 5-10% for over $n \times 10^{-1}$%. (LK)

Separation Procedures

Refer also to abstract 8601.

8479 TETRASUBSTITUTED ALKYLDIAMINES AS EXTRACTANTS OF METAL ACIDOCOMPLEXES. Dmitrienko, S. G.; Mymrik, N. A.; Gibalo, I. M.; Bebikh, G. F. Vestn. Mosk. Univ., Ser. II. Khim.; 16: No. 1, 118-120(1975). (In Russian).

The extraction of niobium by tetrasubstituted alkyldiamines, new amine extractants, from hydrochloric acid solutions has been studied. The effect of HCl, the nature of amines and organic solvents on the degree of extraction has been investigated also. The composition of the compound extracted was found to be $(AmH_2)(NbOCl_4)_2$. It was shown that tetrasubstituted alkyldiamines could by utilized for the quantitative separation of Nb from Fe and Ti. (auth)

8480 MATHEMATICAL MODEL OF ZIRCONIUM EXTRACTION BY TRIBUTYL PHOSPHATE. Nikolaeva, L. S.; Smirnova, N. S.; Evseev, A. M.; Svetovidov, V. I. Vestn. Mosk. Univ., Ser. II. Khim.; 16: No. 1, 26-29(1975). (In Russian).

The possibility of construction of an adequate approximate model of an extractive process on the basis of mathematical form of law of mass action was demonstrated for extraction of zirconium microquantities by tributyl phosphate from nitric acid solutions. (auth)

8481 EXTRACTION OF SCANDIUM AND ZIRCONIUM SALICYLATES BY 1, 10-PHENANTHROLINE. Kochetkova, S. K.; Fadeeva, V. I.; Lopatina, G. S. Vestn. Mosk. Univ., Ser. II. Khim.; 16: No. 1, 70-73(1975). (In Russian).

The extraction of mixed ligand complexes of Sc and Zr with salicylic acid and phenanthroline was studied. These mixed ligand complexes were established to be extracted by chloroform. Sc and Zr complexes were extracted at pH 3.5 to 5.5 and 1 to 2, respectively. Among the double complexes the only extraction of zirconium salicylate was observed to come up to 50 percent. The ratios of components in the mixed ligand complexes were found to be $Sc : H_2Sal : Phen = 1 : 2 : 1$ and $Zr : H_2Sal : Phen = 1 : 2 : 1$. (auth)

8482 DOUBLE–DOUBLE EFFECT IN THE FREE ENERGY AND ENTHALPY CHANGES OF THE EXTRACTION OF HEAVY LANTHANIDES IN THE HDEHP–HNO_3. Fidelis, I. (Inst. of Nuclear Research, Warsaw). pp 1073-1081 of Solvent Extraction. London; Society of Chemical Industry (1974).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The extraction coefficients and separation factors of lanthanides in the HDBP–HNO_3 systems were determined over the range 10 to 50°C. The relative free energy and enthalpy changes were estimated. It was found that the monotonic decrease in the enthalpy changes determined for the series of heavy lanthanides (Gd-Lu) follows the known pattern of regularities i.e. double-double effect. Regular changes in the separation factors (the double-double effect in the first form of presentation) are observed over the whole investigated temperature range. (auth)

8483 INVESTIGATION OF THE KINETICS OF SEDIMENTARY SORPTION OF SCANDIUM, YTTRIUM, AND LANTHANUM ON ANION EXCHANGERS BY THE DYNAMIC METHOD. Kashakashvili, L. L.; Daneliya, A. G.; Kutsiava, N. A.; Eristavi, V. D. (Gruzinskii Politechnical Inst., Tbilisi, USSR). Soobshch. Akad. Nauk. Gruz. SSR; 77: No. 2, 357-360(Feb 1975). (In Russian).

The kinetics of sedimentary sorption of scandium, yttrium, and lanthanum on the AB-17 and AB-16 anion exchangers has been studied. The rate of the sedimentary sorption has been found to be limited by the delivery rate of the substance. (auth)

8484 COMPLEXING OF Th(IV) AND Np(IV) WITH CHLORIDE AND FLUORIDE IONS. Patil, S. K.; Ramakrishna, V. V. (Bhabha Atomic Research Centre, Bombay). Inorg. Nucl. Chem. Lett.; 11: No. 6, 421-428(Jun 1975).

Using dinonylnaphthalene sulfonic acid (HD) as the extractant, the stability constants of chloride and fluoride complexes of Th(IV) and Np(IV), under identical conditions, were determined and are reported. The fluoride complexing of Np(IV) was also studied using thenoyltrifluoroacetone (TTA) as the extractant. (auth)

8485 STUDY OF THE COMPOSITION OF ADSORBED MOLYBDENUM IONS ON ANION EXCHANGERS BY INFRARED SPECTROSCOPY. Vasilenko, L. V.; Kazantsev, E. I. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, 143-145(1975). (In Russian).

Infrared spectra of the anion exchanger were taken on a UR-10 spectrometer in the region of 400 to 1500 cm^{-1} with a NaCl prism. Static conditions were used to obtain granules of anion exchanger having a homogeneous distribution of sorbed anion. On sorption at a pH of 9 at first two adsorption bands were observed at 840 and 905 cm^{-1}, whose relative intensities increased with increasing degree of saturation of the anion exchanger. This adsorption characterizes the sorption of molybdenum in the form of monomeric ions MoO_4^{2-} having a specific charge equal to 2. At a pH of

7 the specific charge of the sorbed anion remains the same as at a pH of 9. However during sorption a significant increase in pH of the filtrate is observed. A hydrogen-bridge complex is formed consisting of MoO_4^{2-} anions and H_2MoO_4 molecules. Besides adsorption at 900 cm^{-1} (valence oscillations of MoO_4^{2-}) a new intense adsorption appears in the region of 855 to 860 cm^{-1} that is characteristic of a molybdic acid compound. At pH of 5 and 3 absorption bands are noted that are characteristic of tetramolybdate anions $Mo_4O_{13}^{2-}$ and partially protonated tetramolybdate anions $HMo_8O_{25}^{3-}$. The infrared studies confirmed earlier conclusions on the composition of molybdenum anions sorbed on anion exchangers. (SJR)

8486 SORPTION OF A NUMBER OF ELEMENTS OF GROUPS 4 TO 8 OF THE PERIODIC TABLE FROM SOLUTIONS OF METAL FLUORIDE–HF(NH_4F.HF OR NH_4F)–H_2O BY THE CATION EXCHANGER KU-2 × 8. Pakholkov, V. S.; Ganyaev, V. P. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, 63-67(1975). (In Russian).

Experimental data are presented on the sorption of Ti, Zr, Hf, Ge, Sn(II), V(IV), Cr(III), Mn(II), Fe(III), Co and Ni from fluoride solutions, and also data on the elution of these elements from the KU cation exchanger. With increasing concentration of HF or NH_4F the amount of element adsorbed by the cation exchanger fall off sharply, especially of elements forming strong fluoride complexes [Ti, Zr, Hf, Sn(II), V(IV) and Fe(III)]. The exchange capacity of the KU-2 × 8 cation exchanger is 4.9 mg/g of air-dried resin. (SJR)

8487 SEPARATION OF TRACE AMOUNTS OF RARE-EARTH ELEMENTS FROM URANIUM IN AQUEOUS–NON-AQUEOUS MEDIA BY ION-EXCHANGE CHROMATOGRAPHY. Wodkiewicz, L.; Dybcynski, R. (Inst. of Nuclear Research, Warsaw). Chem. Anal. (Warsaw); 19: No. 1, 175-184(1974). (In Polish).

The sample of uranyl chloride (1 g) dissolved in, e.g., methanol–12m-HCl (9 : 1) was passed through a column packed with Dowex 1-X8 resin (Cl^- form). The lanthanoid fraction was eluted with the same solvent system; the eluate was then concentrated and further purified by passing it through a column packed with Dowex 50W-X8 resin (H^+ form). The lanthanoids were eluted with 4M-HCl, and determined spectrographically in the eluate after evaporation. The accuracy and precision of the method were checked by neutron activation, a flux of 10^{13} neutrons per sq. cm per sec. for 20 hr. being used; scintillation counting was carried out in a 512-channel analyzer, with a NaI(Tl) crystal. Mixtures of 12M-HCl with other organic solvents, such as acetic acid, for the initial cation-exchange step were also studied. For standard samples containing 1 μg or 4 μg of La per g of uranium good precision and accuracy were achieved. The results of statistical evaluation are tabulated. (Anal. Abstr.)

8488 SPECTROPHOTOMETRIC STUDY OF CONDITIONS FOR FORMATION AND EXTRACTION OF THE COMPLEX OF MOLYBDENUM WITH PYROGALLOL AND ANILINE. Gamid-Zade, G. A.; Ali-Zade, T. D.; Verdiev, G. R.; Selezneva, N. I. Uch. Zap., Azerb. Inst. Nefti Khim., Ser. 9; No. 2, 67-70(1973). (In Russian).

In faintly acid medium (pH 3 to 4), Mo^{VI} forms a ternary complex with pyrogallol and aniline; this complex can be extracted into $CHCl_3$-isoamyl alcohol (1 : 1) to give a soln. suitable for the spectrophotometric determination of 10 to 300 μg of Mo. The ε value of the complex is 7000 at 410 nm. (auth)

8489 USE OF AQUEOUS ORGANIC SOLVENTS IN THE CHROMATOGRAPHIC SEPARATION OF CALCIUM AND STRONTIUM. Milad, N. E.; El-Atrash, A. M.; Abdel Motteleb, M. S. A. (Ain Shams Univ., Cairo). Egypt. J. Chem.; 16: No. 2, 173-177 (1973).

The separation of Ca and Sr was studied by using their tartrate complexes labelled with radioactive tracers and by applying the competitive-solubility method to their citrate complexes. Results are presented for various values of column length, pH, and composition of the solvent medium. Complete separation, with 100% recovery, was obtained for a solution of 0.25 mg of each of Ca and Sr per ml in 0.05M–Na citrate in 15% aq. ethanol at pH = 8.6, with Dowex 50-X8 cation-exchange resin (Na^+ form; 100 to 200 mesh) in a column 25 cm × 1 cm. (Anal. Abstr.)

8490 ENTHALPY AND ENTROPY VARIATIONS IN THE LIQUID CATION EXCHANGE OF SOME LANTHANIDE IONS BY DIONYLNAPHTHALENE-SULFONIC ACID (HD) AND BIS(2-ETHYL-HEXYL) PHOSPHORIC ACID (HDEHP). Danesi, P. R.; Chiarizia, R.; Raieh, M. A.; Scibona, G. (CNEN, Casaccia, Italy). J. Inorg. Nucl. Chem.; 37: No. 6, 1489-1493(Jun 1975).

Free energy, enthalpy and entropy variations concerning the liquid ion exchange reactions of some lanthanides between aqueous perchloric acid solutions and organic solutions of the liquid cation exchangers dinonylnaphthalenesulfonic acid (HD) and bis(2-ethylhexyl)phosphoric acid (HDEHP) have been determined. The meaning of the experimentally obtained thermodynamic quantities is discussed on the basis of structural considerations regarding both the aqueous and the organic phase. (auth)

8491 LIQUID ION EXCHANGE SELECTIVITY OF DINONYLNAPHTHALENESULFONIC ACID(HD) WITH RESPECT TO SOME LANTHANIDE AND ACTINIDE IONS. Chiarizia, R.; Danesi, P. R.; Raieh, M. A.; Scibona, G. (CNEN, Casaccia, Italy). J. Inorg. Nucl. Chem.; 37: No. 6, 1495-1501(Jun 1975).

The liquid ion exchange selectivity of dinonylnaphthalenesulfonic acid (HD) dissolved in a series of organic diluents covering the dielectric constant range 2.38 to 34.8 with respect to the cations Ce^{3+}, Eu^{3+}, Gd^{3+}, Tm^{3+}, Am^{3+}, Cm^{3+}, Cf^{3+} in perchloric solutions has been studied at 25°C. The extent of aggregation of HD in the different diluents and the equilibrium constants of the exchange reactions have been evaluated. As far as the dependence of the ion exchange selectivity on the diluent nature is concerned, a decrease of the selectivity with the increase of the diluent dielectric constant has been evidenced only in the case of M^{3+}–H^+ exchange. The reasons of this behavior are discussed together with literature data concerning other liquid ion exchange systems. (auth)

8492 DYNAMICS OF SORPTION IN THE PRESENCE OF COMPLEXING AGENTS. IV. Effect of Temperature on the Spreading of Chromatographic Bands with Nonlinear Sorption Isotherms. Matorina, N. N.; Buchatskii, P. M.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem.; 48: No. 9, 1344-1347(Sep 1974).

Translated from Zh. Fiz. Khim.; 48: No. 9, 2271-2275.

Investigation of the effect of temperature on ion-exchange sorption isotherms and on the spreading of chromatographic bands in the presence of complexing reagents shows that change of temperature may convert convex into concave isotherms and conversely. The conditions of reversal are determined by a dimensionless equation. The different types of temperature effect on the spreading of chromatographic bands found with different forms of sorption isotherms are shown for the separation of yttrium and cerium by selective elution with aqueous diethylenetriaminepentaacetic acid on KU-2 cation-exchange resin. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 9606.

Chemical and Physicochemical Properties

Refer also to abstracts 8588, 8936, 8941, 9603–9604, 10001, and 10941.

8493 INVESTIGATION OF IR SPECTRA OF SOME SUBOXIDES AND SUBCHALCOGENIDES OF BORON SUBGROUP ELEMENTS BY MATRIX ISOLATION TECHNIQUE. Perov, P. A.; Shevel'kov, V. F.; Mal'tsev, A. A. Vestn. Mosk. Univ., Ser. II. Khim.; 16: No. 1, 109-110(1975). (In Russian).

The IR absorption spectra of Al_2O, Ga_2O, In_2O, Ga_2S, In_2Se, In_2Te and Tl_2Se isolated in the Ar and Xe matrices have been measured in the range 30–2500 cm^{-1}. The assignment of bands was performed. A new interpretation of combination frequencies was suggested which were obtained due to study of these compound spectra in gas phase. (auth)

8494 THE DENSITY AT 25°C OF D_2O WITH NATURAL OXYGEN ISOTOPIC COMPOSITION. Babeliowsky, T.; Brulmans, J. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Z. Naturforsch., A; 30: No. 1, 103-106(Jan 1975).

In measuring the influence of oxygen isotopic composition and of hydrogen content on the density of heavy water an extrapolation was made to 100% D_2O with natural oxygen isotopic composition, starting with the density of a highly enriched heavy water (99.95% D_2O, about natural oxygen isotopic composition). A value of 1,104.481 kg/m^3 at 25°C was obtained. (auth)

8495 THERMAL EXPANSION OF HEAVY WATER BETWEEN 7 AND 26°C. Brulmans, J.; Verdonck, J.; Eschbach, H. L. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Z. Naturforsch., A; 30: No. 1, 107-108(Jan 1975).

Using six carefully calibrated quartz floats the thermal expansion of water with a D_2O content of 99.74 mole % was measured between 7 and 26°C. Extrapolation to 100% D_2O with natural oxygen isotopic composition is made. (auth)

Isotope Effects

Refer also to abstracts 8928 and 9073.

8496 ELIMINATION MECHANISMS. Deuteroxide/Hydroxide Isotope Effects as a Measure of Proton Transfer in the Transition States for E2 Elimination of 2-(p-Trimethylammoniophenyl) Ethyl 'Onium Ions and Halides. Mapping of the Reaction-Coordinate Motion[1]. Winey, D. A.; Thornton, E. R. (Univ. of Pennsylvania, Philadelphia). J. Am. Chem. Soc.; 97: No. 11, 3102-3108(28 May 1974).

Deuteroxide/hydroxide kinetic isotope effects for the compounds p-$(CH_3)_3N^+C_6H_4CH_2CH_2X$ with various leaving groups X, whose syntheses are described herein, were determined at 60°C, as follows (X, k/sub DO^-/k/sub HO^-): $N^+(CH_3)_3$, 1.62 +- 0.12; $N^+(CH_3)_2C_6H_5$, 1.68 +- 0.02; $S^+(CH_3)_2$, 1.54 +- 0.02; F, 1.66 +- 0.03; Cl, 1.40 +- 0.03; Br, 1.30 +- 0.02. These isotope effects are best interpreted as measuring different extents of proton transfer from C/sub beta/ to the attacking lyoxide ion in the concerted E2 transition state, and thus provide a series ranging from more-than-half transfer (isotope effects greater than ca. 1.41, the square root of the maximal isotope effect, ca. 2.0, for complete transfer) to less-than-half transfer. It is also suggested that the data available for E2 reactions best fit transition states which are ElcB-like for poor leaving groups and nearly central for good leaving groups. Significant perpendicular as well as parallel effects in the transition state geometry changes associated with structural changes in reactants explain the data, including the shift to ElcB-like transition states with poor leaving groups, which is considered to be the origin of the Hofmann and Saytzev orientation rules. A "force formulation" of a previously proposed theory of structural effects upon transition-state geometries is also outlined, as a clarification and aid to application of the theory. (auth)

8497 ESR OF THE TRIPLET MOLECULES CCO AND CNN IN RARE-GAS MATRICES; ISOTOPE AND MATRIX EFFECTS. Smith, G.R.; Weltner, W. Jr. (Department of Chemistry, University of Florida, Gainesville, Florida 32611). J. Chem. Phys. 62: No. 12, 4592-4604 (15 June 1975).

CCO and CNN, with isotopic substitution of ^{13}C, ^{18}O, and ^{15}N, were prepared by the reaction of C atoms with CO or N_2 and trapped in various matrices at 4°K. ESR spectra of both $^3\Sigma$ molecules yielded hyperfine splittings, g values, and zero-field splittings. In solid neon, these parameters for $C_\alpha C_\beta O$, assuming $g_\parallel = g_e$, were $g_\perp = 2.0029(4)$, $D = 0.7392(4)$ cm^{-1}, $|A_\parallel(C_\alpha)| = 57(3)$ MHz, $|A_\parallel(C_\alpha)| = 17(3)$ MHz, $|A_\parallel(C_\beta)| = 26(3)$ MHz, $|A_\parallel(C_\beta)| = 32(3)$ MHz. Similar but less extensive data were obtained for $CN_\alpha N_\beta$ where in solid neon, assuming $g_\parallel = g_\perp = g_e$, $D = 1.1590(5)$ cm^{-1}, $|A_\parallel(^{14}N_\alpha)| = 35(5)$, $|A_\parallel(^{14}N_\beta)| = 19(5)$, and $|A_\parallel(^{13}C)| = 50(5)$ MHz. D values for isotopic molecules $^{12}C^{12}C^{16}O$, $^{13}C^{12}C^{18}O$, etc., varied by small but significant amounts (up to about 0.001 cm^{-1}) in Ne and in Ar matrices. These variations could be approximately accounted for by assuming torsional oscillation in the solid. This was supported by a temperature variation study. The observed decrease of $D_{ave} = 0.772$ cm^{-1} for C_2O in matrices, particularly large in Kr and Xe, is attributed partially to motional averaging and partially to matrix perturbations of molecular electronic properties. Theory was applied to qualitatively account for the changes in spin–spin, D_{SS}, and spin–orbit, D_{SO}, contributions to the zfs of the molecule in the solids. Matrix effects are expected to increase D_{SS} and decrease D_{SO} (for positive D) so that the dominant electronic effect is the spin–orbit mixing-in of singlet states via the matrix. (auth)

8498 DYNAMICS OF ACTIVATED CHEMISORPTION: METHANE ON RHODIUM. Stewart, C.N.; Ehrlich, G. (Coordinated Science Laboratory, Department of Metallurgy and Department of Physics, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). J. Chem. Phys. 62: No. 12, 4672-4682 (15 June 1975).

Chemisorption of methane has been examined on highly perfect rhodium surfaces by a combination of field emission and molecular beam techniques in order to explore the mechanism of activation. It has been found that dissociative adsorption can be initiated on rhodium at 245 K just by excitation of the gas. Quantitative rate studies as a function of gas temperature have established that the CH_4 molecule must overcome an activation barrier of 7 kcal mole^{-1} for reaction to occur. For gas temperatures $600 < T_G < 710$ K, the efficiency of chemisorption per impact is at least an order of magnitude smaller for CD_4 than for CH_4 and a factor of $\simeq 3$ smaller for CH_2D_2. This suggests that translational and rotational motion are not directly involved in passing over the barrier. Vibrational excitation of methane molecules appears to be the significant step in the reaction at the surface. Transition state theory fails to account for the significantly smaller rates observed for CD_4 than for CH_4. However, Slater's dynamical model of unimolecular reactions leads to a sizable isotope effect for the rate of dissociation, and the semiquantitative data presently available are best explained by his model. (auth)

8499 ISOTOPIC AND VIBRONIC COUPLING EFFECTS IN THE VALENCE ELECTRON SPECTRA OF $H_2{}^{16}O$, $H_2{}^{18}O$, AND $D_2{}^{16}O$. Karlsson, L.; Mattsson, L.; Jadrny, R.; Albridge, R.G.; Pinchas, S.; Bergmark, T.; Siegbahn, K. (Uppsala University, Institute of Physics, Box 530, S-751 21 Uppsala, Sweden). J. Chem. Phys. 62: No. 12, 4745-4752 (15 June 1975).

Isotopic shift data for He I induced high resolution valence electron spectra of $H_2{}^{16}O$, $H_2{}^{18}O$, and $D_2{}^{16}O$ are presented. From the differences in the vibrational subspectra we were able to deduce adiabatic ionization energies and geometries of the ions and to assign the excited vibrations to normal modes. The ν_2 progression in the $^2A_1$ band was found to be affected by strong vibronic coupling. (auth)

8500 INTERMOLECULAR ^{13}C KINETIC ISOTOPE EFFECTS IN THE DECARBOXYLATION OF OXALIC ACID IN DIOXANE SOLUTION. Huang, T.T.; Kidd, R.W.; Yankwich, P.E. (Department of Chemistry, University of Illinois, Urbana, Illinois 61801). J. Chem. Phys. 62: No. 12, 4757-4763 (15 June 1975).

Intermolecular ^{13}C kinetic isotope effects in the decomposition in dioxane solution of oxalic acid to carbon dioxide and formic acid were determined at several temperatures between 80 and 132°C. The isotope effect is normal in sign ($k^{12}C > k^{13}C$), and approximately 3% in magnitude; the temperature dependence (small over the range of experimental temperatures) may be complex, if real. The method of three-element reaction coordinates (with $\nu^{\ddagger}_1 = 0$) was employed to expose possible properties of the transition state. The reaction coordinate eigenvectors yielding best correspondence to the experimental data consist of C–C bond extension, C–O bond contraction, and either (a) O–H bond extension or (b) contraction of the angle O–C–C to linearize O–C–O, these displacements being sited about the C atom which will appear in carbon dioxide product. The differences in the same region between reactant and transition state force fields which yield calculated results in best agreement with the experimental measurements are $F^{\ddagger}_{C\text{-}C} = 0.125\ F^0_{C\text{-}C}$, $F^{\ddagger}_{O\text{-}H} = 0.5\ F^0_{O\text{-}H}$, $F^{\ddagger}_{C\text{-}O} = 0.875\ F^0_{C\text{-}O}$, and $F^{\ddagger}_{bend} = (C^{\ddagger}/C^0)F^0_{bend}$, where C is the product of the bond orders of the stretching coordinates defining the bond angle. (auth)

8501 MILLIMETER- AND SUBMILLIMETER-WAVE SPECTRUM AND MOLECULAR CONSTANTS OF CUPROUS IODIDE. Manson, E.L.; De Lucia, F.C.; Gordy, W. (Department of Physics, Duke University, Durham, North Carolina 27706). J. Chem. Phys. 62: No. 12, 4796-4798 (15 June 1975).

Monomeric cuprous iodide (CuI) in the vapor state has been produced as an intermediate product of the reaction of copper with iodine vapor at 1100°K in a quasi-free-space microwave absorption cell. Rotational transitions of $^{63}Cu^{127}I$ and $^{65}Cu^{127}I$ were measured for J as high as 87—88 and for v as high as 11. Hyperfine splittings due to ^{127}I were observed, and eqQ (^{127}I) = −935(15) MHz was derived. Analysis of the rotational frequencies yields the following Dunham and equilibrium coefficients for $^{63}Cu^{127}I$:
$Y_{01} = 2197.10172(98)$ MHz, $Y_{11} = -8.51120(66)$ MHz,
$Y_{21} = 0.00934(14)$ MHz, $Y_{31} = -0.0375(88)$ kHz,
$Y_{02} = -0.67269(10)$ kHz, $Y_{12} = 0.031(34)$ Hz,
$Y_{03} = -0.00006858(10)$ Hz, $B_e = 2197.102(2)$ MHz,
$\omega_e = 264.897(18)$ cm^{-1}, $\omega_e x_e = 0.715(2)$ cm^{-1},
$r_e = 2.33831686(104)$ Å; for $^{65}Cu^{127}I$:
$Y_{01} = 2151.89989(94)$ MHz, $Y_{11} = -8.24990(66)$ MHz,
$Y_{21} = 0.00896(14)$ MHz, $Y_{31} = -0.0356(88)$ kHz,
$Y_{02} = -0.64530(10)$ kHz, $Y_{12} = 0.030(34)$ Hz,
$Y_{03} = -0.00006443(10)$ Hz, $B_e = 2151.900(2)$ MHz,
$\omega_e = 262.157(18)$ cm^{-1}, $\omega_e x_e = 0.700(2)$ cm^{-1},
$r_e = 2.33831664(102)$ Å. The Dunham potential constants for CuI are $a_0 = 239\,366(34)$ cm^{-1}, $a_1 = -3.33365(36)$, $a_2 = 7.391(16)$, and $a_3 = -13.20(18)$. (auth)

8502 MICROWAVE SPECTRUM AND RING STRUCTURE OF CYCLOPROPYL CYANIDE. Pearson, R. Jr.; Choplin, A.; Laurie, V.W. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540). J. Chem. Phys. 62: No. 12, 4859-4861 (15 June 1975).

The microwave spectrum of cyclopropyl cyanide has been re-examined and a centrifugal distortion analysis has been carried out. Also, the two isotopic species containing ^{13}C in the ring have been assigned allowing a substitution determination of the ring structure. Parameters found are $r_{12} = 1.528 \pm 0.005$ Å, $r_{23} = 1.500 \pm 0.002$ Å, $\angle C_2C_1C_3 = 58.8 \pm 0.3°$. (auth)

8503 THRESHOLD PHOTOELECTRON–PHOTOION COINCIDENCE MASS SPECTROMETRIC STUDY OF ETHYLENE AND ETHYLENE-d_4. Stockbauer, R.; Inghram, M.G. (Department of Physics, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 62: No. 12, 4862-4870 (15 June 1975).

Experimental curves have been obtained for the fragmentation of ethylene and ethylene-d_4 ions as a function of the internal energy of those ions using threshold photoelectron–photoion coincidence mass spectrometry. The results are compared with the previous results of photoionization mass spectrometry, He I photoelectron-photoion coincidence, charge exchange experiments, and with quasiequilibrium theory (QET) calculations. The discrepancies between results of these previous experiments and QET calculations do not appear in the present data. It is suggested that ion–molecule reactions competing with charge exchange has led to erroneous conclusions in the interpretation of the charge exchange data. It is concluded that QET does describe the

fragmentation of ethylene and ethylene-d_4 within the limits of the data and calculations available. The secondary ion fragmentation $C_2H_4^+ \rightarrow C_2H_3^+ + H \rightarrow C_2H_2^+ + 2H$ is discussed in detail with regard to the $C_2H_3^+$ fragment ion internal energy distribution. (auth)

8504 MIXED ADSORPTION OF CARBON MONOXIDE AND OXYGEN ON TUNGSTEN (100), (110), AND (111) SINGLE CRYSTAL FACES. Anders, L.W.; Hansen, R.S. (Ames Laboratory–USERDA and Department of Chemistry, Iowa State University, Ames, Iowa 50010). J. Chem. Phys. 62: No. 12, 4652-4660 (15 June 1975).

Flash desorption spectra of $C^{16}O$ and $C^{18}O$ were measured for $C^{16}O$ dosed on tungsten (100), (110), and (111) at 300 K with varying $^{18}O_2$ predoses and postdoses. Heavy doses of $C^{16}O$ resulted in flash desorption spectra characterized by a single α peak and two β peaks on each of W(100) and W(110) crystal faces, and single sharp α and β peaks on the W(111) crystal face. Predoses or postdoses of $^{18}O_2$ resulted in extensive isotope exchange in all β peaks, and slight exchange in all α peaks. Postdosing of a $C^{16}O$ monolayer by $^{18}O_2$ resulted in no change in total CO on the surface, although in cases where two β peaks occurred, that state desorbing at lower temperature was enhanced at the expense of that desorbing at higher temperature. With increasing predose of $^{18}O_2$ the total β-CO resulting from a fixed $C^{16}O$ dose steadily decreased, and the amount of α-CO at first increased, then decreased. The results are broadly in accord with the Goymour–King model, according to which β states arise from dissociatively chemisorbed CO, α states from CO associatively adsorbed on isolated single sites. Isotopic exchange at low $C^{16}O$ doses followed by heavy $^{18}O_2$ doses appears best interpreted in terms of random selection of oxygen from immediate neighbors in an immobile monolayer, rather than in terms of random mixing of oxygen isotopes over the entire monolayer. (auth)

8505 VIBRATIONAL SPECTRUM AND INTERNAL ROTATION OF DIMETHYLCYANAMIDE AND TWO ISOTOPICALLY SUBSTITUTED COMPOUNDS. Blackwood, H. D, Jr. Clemson, SC; Clemson Univ. (1974). 125p. University Microfilms Order No. 75-11,509.

Thesis (Ph. D.).

The vibrational spectra of dimethylcyanamide (H-6), dimethylcyanamide-d_3 (D-3), and dimethylcyanamide-d_6 (D-6) were obtained. Vapor and solid phase infrared and liquid phase Raman spectra were observed for the complete vibrational spectral region. Complete assignment of frequencies for the normal modes of vibration were proposed for H-6 and D-6 but assignment of low frequency modes in D-3 was not accomplished. In the solid phase infrared spectrum of each compound was observed one absorption transition which could be assigned to a normal mode representing a torsional motion of the methyl groups. From the torsional transition frequencies were calculated torsional barriers assuming two models: (1) hindered internal rotation and (2) harmonic oscillation. The variance in the barrier value for H-6 and those for D-3 and D-6 indicated significant mixing of a torsional mode in H-6 with a low frequency skeletal mode. Thermodynamic properties were determined by statistical mechanical methods for H-6 and D-6 assuming ideal gas behavior. The models based on hindered rotation and harmonic motion were used for the calculation of the torsional contribution. It was concluded that the hindered rotator model was valid over a wider temperature range than the harmonic oscillator model. (Diss. Abstr. Int., B)

8506 ISOTOPE EFFECT AND PRESSURE COEFFICIENT OF THE SUPERCONDUCTING TRANSITION TEMPERATURE WITHIN THE ELIASHBERG-THEORY. Kessel, W. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany)). Z. Naturforsch., A; 30: No. 2, 250-255(Feb 1975). (In German).

Starting from the observation that both the mass of the ions and their volume control the phonon frequencies by stretching the phonon spectrum, the change of the Eliashberg-equations of the theory of superconductivity regarding these stretchings is considered. General expressions for the isotopic exponent and the pressure coefficient of the transition temperature are derived in which only derivatives of the transition temperature with respect to the fundamental parameters of the theory are involved. A comparison with experimental values shows that lead is not the metal with the highest transition temperature possible under the simple metals. (auth)

8507 ^{3}N, O^4-ETHYLENE-1-METHYLURACILIUM METHANESULFONATE. A Uracil-Derived Heteronuclear Stabilized Cation. Lipkin, D.; Lovett, E. G. (Washington Univ., St. Louis). J. Org. Chem.; 40: No. 12, 1713-1721(13 Jun 1975).

The preparation and properties of ^{3}N, ^{4}O-ethylene-1-methyluracilium methanesulfonate, a heteronuclear stabilized cation, and its interconversions with 3-(beta-methanesulfonyloxyethyl)-1-methyluracil were studied. The former was shown to have three sites for reactions with nucleophilic reagents: the beta carbon of the ethylene moiety and C-4 and C-6 of the pyrimidine ring. Products resulting from attack at the beta position were observed with DMSO, water, alcohols, benzoate, chloride, diethylamine, and pyridine. A strong rate dependence on solvent was noted with chloride ions. Products resulting from attack at C-4 were observed with water, hydroxide, alcohols, alkoxide, and isopropylamine. Diethylamine was the only reagent which led to a product resulting from attack at C-6 of the cation. Oxygen-18 experiments verified the sites at which the uracilium salt reacted with hydroxide and water. Although the N^3, O^4-ethylene-1-methyluracilium cation bears a net positive charge, deuterium exchange reactions were not observed. Mechanisms are proposed to account for the products of the various reactions which were investigated. (auth)

8508 STEADY-STATE ANALYSIS OF KINETIC ISOTOPE EFFECTS IN ENZYMIC REACTIONS. Northrop, D. B. (Univ. of Wisconsin, Madison). Biochemistry; 14: No. 12, 2644-2651 (17 Jun 1975).

The decrease in the rate of bond cleavage resulting from the presence of heavy isotopes is expressed to a greater or lesser extent as an isotope effect on steady-state kinetic parameters of enzyme-catalyzed reactions, depending upon complex relationships between individual rate constants. This paper describes these relationships and derives general kinetic expressions which allow the determination of the limits of the relative contribution of different reaction components to V/sub max/ and V/sub max/K/sub m/. The value of the true isotope effect on a carbon-hydrogen bond breaking step, the rate of this step, and its percentage of partial rate limitation of the overall reaction, plus the dissociation constant of the enzyme-substrate complex, can be determined from the derived expressions by comparing deuterium and tritium isotope effects on V/sub max/K/sub m/. In the absence of a measure of the true isotope effect, the lower limit of primary isotope effects of deuterium which may be interpreted as identifying the slowest or "rate-determining" step in an enzyme-catalyzed reaction is found to be k/sub H/k/sub D/ equals 8, and not k/sub H/k/sub D/ equals 2 as is currently supposed. (auth)

8509 WEAK AND STRONG INTERACTIONS IN CHEMICAL REACTIONS. Baer, M. (Max-Planck-Institut für Strömungsforschung, 34 Göttingen, Germany). J. Chem. Phys. 62: No. 11, 4545-4550 (1 June 1975).

The over-all reactive process is assumed to follow a two-step mechanism where each step is characterized by a different kind of interaction: (i) the weak interaction that takes care of the product rotational distribution; and (ii) the strong interaction that governs the product vibrational distribution. If we make this assumption it is possible to couple three-dimensional classical rotational distributions with collinear quantum mechanical vibrational distributions. This procedure leads to a modified vibrational distribution which is found to be in agreement with experiment. (auth)

8510 METHYL GROUP DEUTERON QUADRUPOLE COUPLING PARAMETERS IN SOLID TOLUENE-d_8, *ortho*- AND *para*-XYLENE-d_{10}. Barnes, R.G.; Harper, W.C.; Torgeson, D.R. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50010). J. Chem. Phys. 62: No. 11, 4572-4572 (1 June 1975).

Quadrupole coupling constants and asymmetey parameters have been determined for the methyl group deuterons in toluene-d_8, $C_6D_5CD_3$, and in *ortho*- and *para*-xylene, *o*-C_6D_4 $(CD_3)_2$ and *p*-$C_6D_4(CD_3)_2$, at 77 K. The coupling constant values are equal within experimental uncertainty, whereas the asymmetry parameters are not. The considerable disparity in effective asymmetry parameters observed in these three compounds shows that significant differences must arise in the rigid bond coupling constants of the individual methyl group deuterons. (AIP)

8511 MULTIPHOTON IONIZATION SPECTROSCOPY: A NEW STATE OF BENZENE. Johnson, P.M. (Department of Chemistry, State University of New York, Stony Brook, New York 11794). J. Chem. Phys. 62: No. 11, 4562-4563 (1 June 1975).

The multiphoton ionization spectra of benzene-h_6 and benzene-d_6 are reported. A resonance is observed which is tentatively assigned to a theoretically predicted $^1E_{2g}$ state; however, an absolute assignment is not possible. (AIP)

8512 ^{129}I MÖSSBAUER STUDIES OF IODINE IN THE +1 AND +3 OXIDATION STATES. Jones, C.H.W. (Chemistry Department, Simon Fraser University, Burnaby, British Columbia, Canada V5A 1S6). J. Chem. Phys. 62: No. 11, 4343-4349 (1 June 1975).

The ^{129}I Mössbauer spectra of $I(pyridine)_2ClO_4$ and $-NO_3$, $I(thiourea)_2I$, $I(acetate)_3$, a possible phosphate derivative I^I-phosphate, and I_2O_4 are reported. Comparisons of the results of these experiments with those of previous workers raise questions concerning the use of simple models in interpreting ^{129}I Mössbauer data. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 8553 and 8931.

8513 DEUTERATION KINETICS OF SUBSTITUTED N-PHENYLPYRIDINIUM SALTS. Machacek, V.; Sterba, V. (Inst. of Chemical Tech., Pardubice, Czech.). Collect. Czech. Chem. Commun.; 40: No. 4, 1163-1165(Apr 1975).

Rate constants were determined of OD^--catalyzed exchange of hydrogen by deuterium at positions 2 and 6 of substituted 1-phenylpyridinium salts. The dependence of log k on σ^+ constants is linear with the slope $\rho = 0.78$. (auth)

8514 A PARADOX: THE THERMAL RATE COEFFICIENT FOR THE H+DCl → HCl+D EXCHANGE REACTION. Thompson, D.L.; Suzukawa, H.H. Jr.; Raff, L.M. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). J. Chem. Phys. 62: No. 12, 4727-4739 (15 June 1975).

Previously reported photolysis experiments indicate that the frequency factors associated with the hydrogen-exchange reactions H+DCl → HCl+D and D+HCl → DCl+H are on the order of 10^{10} cm^3/mol-sec. This result indicates that the above processes are associated with very small steric factors, in contrast to what one might be led to expect from recent crossed beam experiments. A series of unadjusted, quasiclassical trajectory calculations have been carried out to compute the thermal rate coefficients and activation parameters for a series of 13 thermal processes of the type A+BC → AB+C, where A=H, D, or Cl and BC=H_2, D_2, HCl, DCl, or Cl_2. In addition, hot-atom yield ratios have been computed from the IRP equation for the reactions $D^*+DCl \rightarrow D_2+Cl$, $D^*+Cl_2 \rightarrow DCl + Cl$ as a function of the initial D^* laboratory energy. Previously formulated, valence-bond representations were employed for the potential-energy surfaces in all the calculations. The computations yield (1) hot-atom [DCl]/[D_2] yield ratios within a factor of 2 of the experimental values; (2) thermal activation energies in satisfactory agreement with experiment for all processes investigated; and (3) frequency factors in reasonable accord with experiment for all the reactions except the hydrogen exchange reactions, where the computed values are a factor of about 10^3–10^4 larger than indicated by the photolysis experiments. An investigation of a network of elementary thermal reactions that are apparently occurring in the photolysis experiments indicates that the presently computed thermal rate coefficients for the exchange reactions are too large to be compatible with observed HD and D_2 quantum yields. These results make it clear that a serious error exists in either the potential-energy surface, the theoretical scattering calculations, the measured photolysis data, or the interpretation of that data. The agreement of the computed hot-atom yields, rate coefficients, and thermal activation parameters for all reactions except the hydrogen exchange reactions coupled with the results of recent crossed-beam experiments strongly indicate that the error lies in the interpretation of the photolysis data. (auth)

8515 MOLECULAR BEAM KINETICS: EXCHANGE REACTIONS OF DEUTERIUM ATOMS WITH HYDROGEN HALIDES. McDonald, J.D.; Herschbach, D.R. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). J. Chem. Phys. 62: No. 12, 4740-4744 (15 June 1975).

A crossed-beam study finds the reactions of D atoms with HCl, HBr, and HI give large yields of DCl, DBr, and DI, corresponding to reaction cross sections of the order 1–10 $Å^2$. This demonstrates that the exceptionally small steric factors or transmission coefficients previously inferred from analysis of chain reaction mechanisms are low by several orders of magnitude. The reactively scattered deuterium halides recoil predominantly into the backward hemisphere with respect to the incident D atoms. In each case, the reaction exoergicity is ~1 kcal/mole and the mean initial collision energy is ~9 kcal/mole (with the D beam at 2800 °K, the hydrogen halide at 250 °K). The most probable final relative translational energy of the products is $\gtrsim$ 4 kcal/mole for the HCl and HBr reactions and 7 kcal/mole for the HI reaction. The magnitude of the reaction cross sections and the predominant backward recoil and translational energy of the products are consistent with recent classical trajectory calculations based on semiempirical potential surfaces. (auth)

8516 EXCHANGE OF ALKANES WITH DEUTERIUM OVER γ-ALUMINA. A Broensted Linear Free Energy Relationship. Robertson, P. J.; Scurrell, M. S.; Kemball, C. (Univ. of Edinburgh). J. Chem. Soc. (London), Faraday Trans., I.; 71: No. 4, 903-912(1975).

The exchange behavior of a series of alkanes, including cycloalkanes, with deuterium over γ-alumina has been investigated. Different types of hydrogen atoms within the same molecule are found to exchange at different rates and in some cases a quantitative estimate of the relative activities has been made. These results and a comparison of reaction rates of different molecules indicate that the reaction intermediates are carbanionic in character. A linear relation between hydrogen exchange activity and hydrocarbon acidity has been obtained and is shown to be an example of the Bronsted catalysis law. All the exchange reactions took place in a stepwise manner and, for the cycloalkanes, exchange could be followed at lower temperatures without complication from isomerization and addition. (auth)

8517 CLOSED LOOP REFLUX SYSTEM. De Witt, R.; Jepson, B. E.; Schwind, R. A. (to U.S. Atomic Energy Commission). US Patent 3,869,255. B01d3/00; B01d59/12; C01b17/48. 4 Mar 1975. Filed date 10 Jan 1973. 5p.

PAT-APPL-322,566.

Sulfur isotopes are continuously separated and enriched using a closed loop reflux system wherein sulfur dioxide (SO_2) is reacted with sodium hydroxide (NaOH) or the like to form sodium hydrogen sulfite ($NaHSO_3$). Heavier sulfur isotopes are preferentially attracted to the $NaHSO_3$, and subsequently reacted with sulfuric acid (H_2SO_4) forming sodium hydrogen sulfate ($NaHSO_4$) and SO_2 gas, which contains increased concentrations of the heavier sulfur isotopes. This heavy isotope enriched SO_2 gas is subsequently separated and the $NaHSO_4$ is reacted with NaOH to form sodium sulfate (Na_2SO_4), which is subsequently decomposed in an electrodialysis unit to form the NaOH and H_2SO_4 components, which are used in the aforesaid reactions thereby effecting sulfur isotope separation and enrichment without objectionable loss of feed materials. (auth)

8518 SYNTHESIS OF DEUTERATED TERMINAL OLEFINES FROM CARBONYL COMPOUNDS AND [$^2H_2$]METHYLENE IODIDE. Hasselmann, D. (Bochum Univ. (F. R. Germany). Abt. fuer Chemie). Chem. Ber.; 107: No. 11, 3486-3493(1974). (In German).

Deuterated terminal olefines were synthesized from carbonyl compounds, [$^2H_2$]methylene iodide and magnesium amalgam. Contrary to the Wittig reaction neither loss nor scrambling of the label occurred in the products. This synthetic approach could be extended to strained bicyclic systems. The method represents a valuable alternative to other olefination reactions. (auth)

8519 CATALYTIC DECOMPOSITION OF HYDRAZINE ON PALLADIUM. Ertl, G.; Tornau, J. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Physikalische Chemie und Elektrochemie). Z. Phys. Chem. (Frankfurt); 93: No. 1-6, 109-118 (Nov 1974). (In German).

The catalytic decomposition of hydrazine at clean Pd surfaces (polycrystalline wire) was studied by mass spectrometry under UHV conditions. Additional information was obtained from deuterium isotope exchange and flash desorption experiments. Isotopic exchange of hydrogen was observed at room temperature and proceeded via a Langmuir-Hinshelwood mechanism. Under steady-state conditions N_2, H_2 and NH_3 were formed in comparable amounts; around 450°K nearly complete decomposition occurred. The rate of ammonia formation increased in proportion to $\sqrt{\text{sub}}(PH2)$ if hydrogen was added. A reaction mechanism is proposed whereafter $N_2H_4 \rightarrow N_2H_3 + H$ is a decisive step and NH_3 is formed via successive hydrogenation of N_2H_4. (auth)

8520 HYDROGEN–DEUTERIUM EXCHANGES IN NUCLEOSIDES AND NUCLEOTIDES. A Mechanism for Exchange of the Exocyclic Amino Hydrogens of Adenosine. Cross, D. G.; Brown, A.; Fisher, H. F. (Veterans Administration Hospital, Kansas City, MO). Biochemistry; 14: No. 12, 2745-2749(17 Jun 1975).

The pH dependence of the apparent first-order rate constant for the exchange of the exocyclic amino hydrogens of adenosine with deuterium from the solvent was measured by stopped-flow ultraviolet spectroscopy. This dependence shows acid catalysis, base catalysis, and spontaneous exchange at neutral pH values. A study of the effect of several buffers on the rates of exchange reveals both general acid and general base catalytic behavior for the exchange process. We propose a general mechanism for the exchange which requires N-1 protonated adenosine as an intermediate for the acid-catalyzed exchange and amidine anion for the base-catalyzed exchange. In both cases the rate-limiting step is the base-catalyzed abstraction of a proton from the exocyclic amino moiety. Evaluation of the rate constants predicts the equilibrium for the exocyclic amino/imino tautomers to be 6.3×10^3:1. (auth)

8521 THE NUCLEAR MASS DEPENDENCE OF THE ADIABATIC CORRECTION TO THE BORN-OPPENHEIMER APPROXIMATION. Bardo, R.D.; Wolfsberg, M. (Department of Chemistry, University of California, Irvine, California 92664). J. Chem. Phys. 62: No. 11, 4555-4558 (1 June 1975).

A simple formula is derived for the nuclear mass dependence of the adiabatic correction to the Born–Oppenheimer approximation for molecules with zero total angular momentum in nondegenerate electronic states. The importance of this result to the calculation of isotopic exchange equilibrium constants is pointed out. (auth)

Feed Materials Processing

Refer also to abstract 8897–8898.

8522 PREPARATION OF URANYL GEL SPHERICAL PARTICLES FOR FAST REACTOR FUELS BY THE SOL-GEL

METHOD. Urbanek, V.; Baran, V. (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 21: No. 2, 51-57(Feb 1975).

The principle of the preparation of uranyl gel spherical particles by the help of internal gelation method is described. The gelatinous product shaped to regular spheres with the diameter of 0.01 to 5.0 mm represents the basis for the preparation of sintered fuel particles used in some types of advanced fast reactors as well as high-temperature gas cooled reactors. The composition of uranyl nitrate–hexamethylentetramine–urea–water systems was determined that yielded gels with suitable mechanical properties and acceptable behavior in the subsequent stages of the process. Based on the up to the present time obtained experimental results, some problems are discussed of the mechanism of the conversion of the initial solutions to the gel solidificates. A semicontinuous column was built and tested for the preparation of gel particles with the diameter between 0.5 and 5.0 mm and with the production capacity of 1.5 kg of spheres per hour. (auth)

8523 HYDROGEN PEROXIDE PRECIPITATION OF URANIUM AT THE ATLAS MINERALS URANIUM MILL. Caropreso, F. E.; Badger, W. P. Trans. Soc. Min. Eng. AIME; 254: 281-284 (1973).

A hydrogen peroxide precipitate process was adopted by Atlas Minerals for the recovery of uranium oxides from sodium chloride strip solutions. Adoption of the process was based on laboratory and plant tests comparing hydrogen peroxide with other precipitants. Plant operation demonstrated that the hydrogen peroxide process consistently yields U concentrates of high purity and barrens of low U content. Increased U_3O_8 concentration in the product, reduced levels of impurities which incur penalties and higher product density have produced economic advantages. (Metals Abstr.)

8524 RIO ALGOM INVESTIGATIONS INTO PRECONCENTRATION OF URANIUM ORE. Grimes, M. E. Trans. Soc. Min. Eng. AIME; 254: 312-318(1973).

Rio Algom Mines Ltd. owns eight U mines and mills in the Elliot Lake district of Ontario, seven of which were producing before 1960. At present only one mine is operating and meeting current contract requirements. Under present economic conditions, it is not feasible to mine ore of less than 2.0 lb/ton U_3O_8, although there are very large reserves below this grade. Rio Algom is interested in preconcentration for three possible applications: to extend ore reserves by permitting use of lower grade ore, to reduce costs on processing of present grade ore, and to reduce capital investment in expanding production to meet future production goals. Rio Algom has been investigating various applicable preconcentration processes since the early 1950s to date on laboratory and pilot-plant scale. Methods investigated include gravity concentration by sink-float, high-intensity wet magnetic separation, flotation of U, flotation of acid consumers, and a number of electronic sorting methods including radiometric, photometric, and conductimetric. No method tested has yet been satisfactory under Rio Algom's criteria of U recovery and cost, principally because U loss has been too high for a useful weight rejection. Metallurgical results of the preconcentration test work and the economic assessment therefrom are reviewed. (Metals Abstr.)

8525 NEW OPTIONS FOR URANIUM RECOVERY. Can. Chem. Process.; 59: No. 4, 31; 33(Apr 1975).

In 1974, Canada's three producers of uranium produced 8.8 million lb. of yellowcake (U_3O_8). The expected price increase from the present $13/lb to $20/lb by 1980, has accelerated the search for uranium ore. Strong-acid leaching techniques may make the recovery of low-grade uranium ore, hitherto uneconomical to process, economically attractive. The use of bacteria as a leaching agent for uranium ore processing is being examined. (CA)

8526 RANSTAD: A PLANT FOR PRODUCTION OF URANIUM FOR SWEDISH NUCLEAR REACTORS. Ingenioer-nytt.; 11: No. 15, 12-13; 46(18 Apr 1975). (In Norwegian).

A preproject has been carried out in 1972-74 by AB Atomenergi and Vattenfallsstyrelsen in Sweden, whose object was to plan the expansion of uranium production at Ranstad from the present pilot scale to 1275 tonnes/yr from 1980 for a 25 year period. The main reason is to ensure uranium supplies for the Swedish nuclear power plants, but it is also possible that production can be commercially profitable. It is estimated that the proposed rate of production can be maintained for 200 years. Most of the ore lies so deep that underground mining will be necessary, but an area of 5 km^2 may be exploited by open cast methods. The ore will be crushed, ground and sorted before leaching in sulfuric acid, and thereafter organic liquid extraction of uranium. Special attention has been paid to the work environment, ventilation, and dust prevention, and to the environment, waste disposal, and pollution. The plans have been sent to a wide range of authorities and organizations for comments and require government approval. (NO)

Radiation Chemistry

Refer also to abstracts 9068, 9070–9071, and 9599.

8527 (AED-CONF-74-465-020) PROBLEMS CONCERNING THE OXIDATION STABILIZATION OF RADIATION-INDUCED CROSS-LINKING OF POLYETHYLENE. von Gentzkow, W.; Wiedenmann, R. (Siemens A. G., Berlin (F. R. Germany)). 1974. 10p. (In German). INIS.

From discussion meeting on radiation chemistry of the polymers; Garching/Muenchen, F. R. Germany (23 Oct 1974).

For comparative investigations of the stabilizing effect of oxidation inhibitors in radio-induced crosslinked polyethylene, these 100 μ foils incorporated in low-density polyethylene and pressed out were crosslinked with electron radiation of dose 200 kJ/kg (20 Mrad) at room temperature. A 750-kV cascade electron accelerator with an electron beam power of 4 kW was available as radiation source. The foil thickness of 100 μ was chosen in order to ensure an oxidative aging course of the crosslinked polyethylene independent of the oxygen diffusion. (GE)

8528 (COO-38-815) SELECTED SPECIFIC RATES OF REACTIONS OF TRANSIENTS FROM WATER IN AQUEOUS SOLUTION. II. Hydrogen Atom. Anbar, M.; Ross, A. B. (Stanford Research Inst., Menlo Park, Calif. (USA); Notre Dame Univ., Ind. (USA). Radiation Lab.). May 1975. Contract E(11-1)-38. 63p. (NSRDS-NBS-51). Dep. NTIS $6.25.

Rates of reactions of hydrogen atoms (from radiolysis of water and other sources) with organic and inorganic molecules, ions, and transients in aqueous solution were tabulated. Directly measured rates obtained by kinetic spectroscopy or conductimetric methods, and relative rates determined by competition kinetics are included. (auth)

8529 (IRI-133-74-06) IONIZATION IN THE TRACK OF A HIGH-ENERGY ELECTRON IN HYDROCARBON LIQUIDS: STUDY OF POSITIVE AND NEGATIVE ION SCAVENGING USING NANOSECOND PULSE RADIOLYSIS. Zador, E.; Warman, J.; Hummel, A. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1974. 38p. INIS.

The lifetime distribution of the charged particles in the track of a high-energy electron in cyclohexane and isooctane was considered. Results on the decay of biphenyl ions in solutions of biphenyl obtained by means of pulse radiolysis with nanosecond time resolution were compared with lifetime distributions calculated from the concentration dependence of the steady state scavenging, using recently determined absolute rate constants for reaction of excess electrons and mobilities of the charged species. The discrepancy is relatively small for cyclohexane but large for isooctane. It is concluded that the scavengers considerably effect the initial spatial distribution of the charged species in the track. The kinetics of the reaction of the positive species in cyclohexane and isooctane with biphenyl, TMPD, and pyrene were considered. The mobile positive species in cyclohexane reacts with pyrene with a rate constant of 5×10^{11} $M^{-1}s^{-1}$, and has a lifetime of 50 ns. In isooctane no evidence for the existence of a mobile positive species has been obtained. (NL)

8530 (RRL-3238-522(Q-71)) QUARTERLY REPORT, JANUARY 1, 1975–March 31, 1975. (Mellon Inst. of Science, Pittsburgh (USA). Radiation Research Labs.). 4 Apr 1975. Contract AT(11-1)-3238. 29p. Dep. NTIS $4.50.

Abstracts of reports issued during the quarter and submitted for publication are compiled. Other work in progress includes the study of the effect of substitution on the ESR parameters of nitro-aromatic radical anions, rate of electron transfer between (acetone) and acetone in aqueous solution, ESR study of dissociation of NH protons of peptide radicals, oxidation of alcohols by sulfate radical, pulse radiolysis studies of phenyl radicals, conversion of hydroxphenyl to phenoxyl radicals, oxidation of cyclohexadienyl radicals by ferricyanide, reactions of SO_4^- with uracil and related compounds, radiation chemical studies on aqueous solutions of alcohols, production of Br^- in radiolysis of mixtures of malonic and bromomalonic acid in solution, skeletal rupture in the radiolysis of normal hydrocarbons, radiolysis of aqueous benzene solutions, traveling wave solutions to reaction-diffusion equations, and triplet sensitized isomerization of maleic and fumaric acids. (JSR)

8531 (SAND-74-5415) TREATMENT OF SEWAGE SLUDGE WITH COMBINATIONS OF HEAT AND IONIZING RADIATION (THERMORADIATION). Sivinski, H. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 20p. (CONF-750316-1; SM-194/303). Dep. NTIS $4.00.

From symposium on the use of high level radiation in waste

treatment status and prospects; Munich, F. R. Germany (17 Mar 1975).

This paper describes research on the application of a combined heat and ionizing radiation treatment to sewage sludge. This treatment can be optimized to maximize synergistic biological inactivation of pathogens such as bacteria, viruses, and parasites. The enhancement of desirable chemical and physical effects resulting from this treatment are also being studied. (auth)

8532 STRUCTURE OF RADICALS PRODUCED BY γ-RADIOLYSIS. Radicals Produced by γ-Radiolysis of 3-Ethylpentane. Mel'nikov, M. Ya. Vestn. Mosk. Univ., Ser. II. Khim.; 16: No. 1, 55-57(1975). (In Russian).

It was shown that by γ-radiolysis of 3-ethylpentane the radicals $CH_3CHCH(C_2H_5)_2$ are formed. By γ-irradiation of 3-ethylpentane in the adamantane matrix at room temperature, the radicals $C(C_2H_5)_3$ are formed. (auth)

8533 RADIOLYSIS OF NaBr CRYSTALS. Tsai, N. A.; Karavan, Yu.V.; Didyk, R. I.; Dragan, O. P. (Lvov State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 16: No. 8, 1591(Feb 1975).

Translated from Fiz. Tverd. Tela; 16: No. 8, 2440-2441(Aug 1974).

When NaBr-O^{2-} crystals are irradiated in the temperature interval between room temperature and 165°C, bromine is liberated. Dependence of the Br+ ion current upon the temperature and the time of irradiation was studied. (LK)

8534 DECOMPOSITION OF HYDROGEN PEROXIDE ON A TWO-COMPONENT, PRE-IRRADIATED CATALYST OF THE TYPE NiO-ZnO. Mucka, V; Cabicar, J. (Czech Technical Univ., Prague). Collect. Czech. Chem. Commun.; 40: No. 4, 947-953(Apr 1975).

Catalytic activities are described of two-component catalysts NiO-ZnO differing in composition and influenced by pre-irradiation with γ rays and neutrons. The irradiation had a significant effect on the catalytic properties. The degree of this effect was strongly dependent on the composition of a catalyst. The experimental evidence suggests that the effect was a result of two effects. One was markedly heat-stable; most likely it was the effect of radiation on the nickel in the catalyst. The other effect was rather labile, being positive or negative, depending on composition; qualitatively it can be ascribed to the influence of radiation on the adsorption-desorption equilibria of different forms of oxygen on the surface of the catalyst. (auth)

8535 RADIATION POLYMERIZATION OF ETHYLENE WITH 2-PROPANOL. Zagorets, P. A.; Shostenko, A. G.; Dodonov, A. M.; Akhmatshin, E.Kh. (Moscow Physical-Technological Inst.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 18: No. 2, 289-292(1975). (In Russian).

A study was made of the radiation polymerization of ethylene with propanol-2 in the temperature interval of 30 to 180°C at various ratios of initial reagents. Only one homologous series of alcohols is formed with the general formula $(CH_3)_2C(OH)(C_2H_4)_nH$, where n is the number of monomeric links that have been added. Radiation yields are tabulated for polymerization products with n = 1, 2, 3, 4, 5 and 6 at temperatures of 30, 60, 100, 125, 150, and 180°C. (SJR)

8536 PHONON STRUCTURES OF OPTICAL ABSORPTION BANDS OF RADICALS PRODUCED BY IRRADIATION IN NAPHTHALENE SINGLE CRYSTALS. Nakagawa, K.; Itoh, N. (Nagoya Univ., Japan). Mol. Cryst. Liq. Cryst.; 28: No. 3-4, 339-344 (Sep 1974).

The paper describes the phonon sidebands of the 539 nm band of the hydronaphthyl radical (H_2-$C_{10}H_7$) and the 712 nm band of the hydrobinaphthyl radical (H_2-$C_{10}H_7$-$C_{10}H_7$). The phonon bands of both transitions are compared with the state density of the lattice phonons obtained from the sidebands of $^3B_{1u} \rightarrow {}^1A_g$ phosphorescence, Raman spectra and theoretical calculation. Experimental details are presented, and the results are discussed. (UK)

8537 RADIATION MECHANISMS. I. Inorganic Salts in Aqueous Solutions: Electron Spin Resonance Studies of γ-irradiated Aqueous Glasses Containing Oxyanions. Ginns, I. S.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc. (London), Dalton Trans.; No. 6, 514-521(1975).

Acidic, neutral, and alkaline aqueous glasses containing the anions perchlorate, chlorate, chlorite, perbromate, bromate, sulfate, sulfite, selenate, selenite, phosphate, hydrogen phosphite, and arsenate have been exposed to ^{60}Co γ-rays at 77°K and their ESR spectra recorded. Primary products detected include e_c^-, $\dot{O}H(\dot{O}D)$, $\dot{H}(\dot{D})$, $\dot{O}^-$, and in certain instances species formed from the oxyanions by electron-capture (e.g. $\dot{S}eO_4^{3-}$, $\dot{A}sO_4^{4-}$) or hole-capture (e.g. $P\dot{O}_4^{3-}$, AsO_4^{3-}). On annealing above 77°K, reactions between the primary species from water and the oxyanions were observed (e.g. $\dot{O}H + HPO_4^{3-} \rightarrow H_2O + \dot{P}O_4^{3-}$; $\dot{O}H + SeO_4^{3-} \rightarrow HOS\dot{e}O_3^{3-}$). These results of "temperature resolved" processes are compared with those from pulse-radiolysis optical studies, and steady-state ESR studies. (auth)

8538 OXIDATION OF TRYPTOPHAN BY RADICAL ANIONS. Redpath, J. L. (Michael Reese Hospital, Chicago); Ovadia, J.; Grossweiner, L. I.; Santus, R. Int. J. Radiat. Biol.; 27: No. 2, 201-204(Feb 1975).

The initial radiolysis reactions of aqueous tryptophan (Trp) are important in connection with the radiation inactivation of enzymes. A short study has been undertaken to explore the possibility that the anion radical reaction products with Trp are the same as those obtained by photochemical oxidation. Parallel pulse radiolysis measurements were made on Trp and 1-MeTrp to differentiate between neutral and cationic species; the irradiations were carried out with 0.5 μsec pulses of 2.8-MeV electrons at 0.5 to 1.5 krads per pulse. The transient spectra from pulse radiolysis of 800 μM Trp and 1-MeTrp in N_2O-saturated pH 7 phosphate buffer (1 mM) were compared with those obtained after the addition of either 0.1 M Br^- or 0.1 M CNS^-. The results indicated that one-electron oxidation is the major mode of radical anion attack on tryptophyl residues in enzymes. The actual mechanism may involve direct electron transfer or take place via adduct formation. Comparison with published results for tyrosine suggested that a similar electron transfer mechanism operates for radical anion attack on tyrosyl residues. (UK)

8539 OPTIMUM CONDITIONS FOR ELECTRON MICROSCOPY OF RADIATION-SENSITIVE POLYMER CRYSTALS. White, J. R. (Queen Mary Coll., London). Polymer; 16: No. 3, 157-160(Mar 1975).

The use of low electron-image magnifications reduces the electron dose suffered by a specimen during the recording of the image, and can result in a valuable extension of the life-time of a radiation sensitive polymer crystal. At magnifications of approximately 1000× the resolution is determined by the characteristics of the photographic recording plate, and is of the order of 300 Å. It is shown, however, that this is adequate for many of the studies of current interest, and that the benefits resulting from increased lifetime will usually outweigh the detrimental effect on resolution. Particular attention is given to Moiré patterns and dislocation images, and to the problem of focusing when operating at sub-visual levels. (auth)

8540 SYNTHESIS AND STUDY OF POLYVINYL ALCOHOL-POLYVINYLPYRROLIDONE GRAFT COPOLYMER SOLUTIONS. Tashmukhamedov, S. A.; Karabaev, A. Sh.; Fuzailov, Sh.; Larin, P. P.; Tillaev, R. S.; Usmanov, Kh. U. (Tashkent State Univ.). Acta Chim. Acad. Sci. Hung.; 84: No. 3, 343-351(1975). (In Russian).

Graft copolymers of poly(vinyl alcohol) with poly(vinyl pyrrolidone) were synthesized by a radiation-chemical method, varying the irradiation dose and the nature and concentration of the solvent. The products obtained were identified by ir spectroscopy. The temperature dependence of the viscosity of the graft copolymers is anomalous; viscosity curves revealing extrema are observed. This phenomenon is interpreted in terms of a possible change in the conformation of the graft copolymer from an aggregative form to a random coil state. Sorption and calorimetric experiments showed that in the process of grafting vinyl (pyrrolidone) to poly(vinyl alcohol), a more compact polymer structure is obtained. (auth)

8541 STUDY OF STRUCTURAL CHANGE IN LINEAR POLYETHYLENE BY ELONGATION IN VIEW OF BEHAVIOR OF FREE RADICALS INDUCED BY γ-IRRADIATION. Kusumoto, N.; Haga, Y.; Motozato, Y. (Case Western Reserve Univ., Cleveland). Polymer; 16: No. 3, 229-231(Mar 1975).

It has been reported [Kusumoto et al., Polym. Sci. (A-2) 9, 1173 (1971) and Polym. Sci. (A-1) 7, 1773 (1969)] in a study of gamma-irradiation effects on polymers that radicals preferentially form in the noncrystalline phase including defects and the amorphous phase. The observation of radical behavior in irradiated polymers may become an invaluable tool for studying the defect of polymer crystals. This method has been used (Nagamura et al, Polym. Sci. (Polym. Phys. Edu.) 11, 2357(1973)) to elucidate the structural change in the crystalline phase of polyethylene subjected to a cyclic tensile stress. The present communication deals with the application of the method to the study of the structural change in polyethylene by elongation. (auth)

8542 EFFECTS OF ETHANOL ON THE RADIOLYSIS OF RIBONUCLEASE. Schuessler, H. (Erlangen-Nuernberg Univ., Erlangen, Ger.). Int. J. Radiat. Biol.; 27: No. 2, 171-180(Feb 1975).

The dependence of D_{37} on the ribonuclease concentration was measured for the depolymerase and hydrolase activity. Ethanol

gave different radiation protection to the two functions by $OH^{\cdot}$-scavenging. Evidence for the reaction of ethanol radicals was obtained by simultaneously scavenging hydrated electrons, $OH^{\cdot}$- and most of the $H^{\cdot}$-radicals without increase in the radiation protection. The efficiency of the individual primary radicals and the ethanol radicals in inactivating ribonuclease was calculated from the measured inactivation yield. (auth)

8543 RADIATION AND CHEMICAL PROCESSES OCCURRING IN VIOMYCIN SULPHATE UNDER THE INFLUENCE OF GAMMA RADIATION. Jezowska-Trzebiatowska, B. (Univ., Wroclaw); Dziegielewski, J.; Kuduk-Jaworska, J.; Kalecinska, E.; Kalecinski, J.; Nowojska, J. Nukleonika; 20: No. 3, 247-261(1975).

The yields of radiation decomposition of viomycin sulfate were determined by the spectrophotometric and spectropolarimetric methods and the yields of radicals and of gaseous products were measured. The results of spectroscopic studies (ir, NMR, uv) and the results of amino acid analysis on irradiated viomycin sulfate as well as precipitation and examination of the radiolysis products enabled to suggest chemical processes induced by gamma radiation. The studies carried out indicate a slight decomposition (1-2%) of viomycin sulfate at the Mrad dose range. (auth)

8544 INVESTIGATION OF γ-RADIOLYSIS OF AQUEOUS SOLUTIONS OF ARSENITES. Mamaladze, M. V.; Nanobashvili, E. M. (Inst. of Inorganic Chemistry and Electrochemistry, Tbilisi, USSR). Soobshch. Akad. Nauk. Gruz. SSR; 77: No. 2, 373-376(Feb 1975). (In Russian).

The radiolysis of aqueous solutions of arsenites in various conditions was studied. In the system 10^{-3} M $Na_2HAsO_3-H_2O$, at pH = 2.2, the oxidation of arsenite ions to arsenate is observed. The yields of the formed arsenate and hydrogen peroxide are equal to $G(As^{5})$ = 3.0 ± 0.12; $G(H_2O_2)$ = 4.1. In the system $5\cdot10^{-2}$ M $Na_2HAsO_3 - H_2O$, at pH ~ 10, reduction of As (III) ions to arsenic is also observed, yielding $G(As^{0})$ = 3.1 ± 0.3. The values of the yields of the above mentioned systems radiolysis products were calculated by the steady-state method. These values are in good agreement with the experimental data. (auth)

8545 RADICALS FORMED AFTER ELECTRON ATTACHMENT TO 5-HALOURACILS IN AQUEOUS GLASSES. Sevilla, M. D.; Failor, R.; Zorman, G. (Oakland Univ., Rochester, MI). J. Phys. Chem.; 78: No. 7, 696-699(1974). (COO-2364-4).

Radicals produced after electron attachment to 5-bromo-6-methyluracil and the 5-halouracils at 77°K in neutral (12 M LiCl) and alkaline (8 M NaOH) aqueous glasses have been investigated by esr spectroscopy. Electron attachment to 5-bromo-6-methyluracil in 12 M LiCl at 77°K results in an anion radical. The anion dehalogenates upon warming at 150°K to form the 6-methyluracil-5-yl radical. Esr spectra indicate that upon further warming this second species undergoes hydrolysis to form the 5-hydroxy-6-methyl-5,6-dihydrouracil-6-yl radical. The results for the halouracils in 12 M LiCl suggest stable anions for bromo-, chloro- and fluorouracil at 77°K. Warming the bromouracil anion to 155°K results in a spectrum attributed to the uracilyl radical. Warming to 165°K results in the hydrolysis of the uracilyl radical to form a radical analogous to that found for 5-bromo-6-methyluracil. The fluorouracil and chlorouracil radical anions remained stable throughout the temperature range investigated. In 8 M NaOD the π anions were found to be somewhat less stable. The π anions of 5-bromo-6-methyluracil were not observed at 77°K; however, those of chloro- and fluorouracil were observed. The difference in stability of the anions in the two glasses is attributed to the fact that the nitrogens are protonated in the neutral glass whereas they are not in the alkaline glass. In addition protonation of the anion at an oxygen in the neutral glass is also likely. This would produce a neutral radical and result in further stabilization. (auth)

8546 ELECTRON SPIN RESONANCE STUDY OF THE SULFIDE RADICAL ADDUCTS TO UNSATURATED COMPOUNDS. Kirino, Y.; Fessenden, R. W. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 79: No. 8, 834-839(1975).

Addition of the sulfur-containing intermediate produced by OH reaction with sulfide to a number of unsaturated compounds was studied by means of ESR spectroscopy. Eight types of compounds were used: aliphatic compounds containing C=C (olefinic compounds and enols), C≡C, C=N (oximes and an imine), or C=S bonds, benzenes, furans, pyrroles, and thiophenes. Adduct radicals containing sulfur were detected only in the case of some olefinic compounds and oximes. The lack of detectable lines in the other cases is most likely the result of slow reaction of the intermediate. Values of the pK for dissociation of the sulfhydryl proton in three β-mercaptoalkyl radicals were determined. The values are for $HSCH_2\dot{C}HCO_2^-$, 8.9, for $HSCH_2\dot{C}HCN$, 7.1, and for $HSCH_2\dot{C}(CH_3)CO_2^-$, 9.5. A study of the temperature dependence of line broadening in $-SCH_2\dot{C}HCO_2^-$ and $-SCH_2\dot{C}(CH_3)CO_2^-$ gave values for the activation energy for internal rotation by 180° about the $CH_2-\dot{C}$ bond of 7.1 and 6.2 kcal mol^{-1}, respectively. (auth)

8547 IRRADIATION OF MONOMER-IMPREGNATED SAWDUST TO PRODUCE NEW CONSTRUCTION MATERIALS. Burillo de V., G.; Loyola, V. V. M.; Echenique-Manrique, R.; Galvez, C. L.; Azamar, B. J. A. (Universidad Nacional Autonoma de Mexico, Mexico City). J. Radiat. Curing; 2: No. 2, 2-6(Apr 1975).

A new construction material was prepared by gamma radiation with or without heat curing, of methyl methacrylate monomer mixed with foaming agent and pine sawdust. The composite with the greatest hardness, bending strength, dimensional stability and lowest water absorption was prepared at a total dose of 1.0 Mrad, a ratio of sawdust/monomer of 8 g/20 ml, and VAZO to monomer of 1.5 percent. The composite appears to be a promising material for use in housing construction for items such as window and door frames, studs, wall partitions, furniture components, etc. (auth)

8548 KINETICS OF DEPROTONATION OF ORGANIC FREE RADICALS IN WATER. Reaction of $HOCHCO_2^-$, $HOCHCONH_2$, and $HOCCH_3CONH_2$ with Various Bases. Bell, J. A. (Army Natick Labs., MA); Grunwald, E.; Hayon, E. J. Am. Chem. Soc.; 97: No. 11, 2995-3000(28 May 1974).

The technique of pulse radiolysis was used to observe the radicals $HOCHCO_2^-$ (I), $HOCHCONH_2$ (II), and $HOCCH_3CONH_2$ (III) in aqueous solution at 22 +- 1^0. The radicals were produced by hydrogen-atom abstraction from the respective parent compounds by OH radicals. Rate constants are reported for that reaction, as well as for the decay of the free radicals and of their conjugate bases. The transient absorptions of the radicals and of their conjugate bases are sufficiently different to permit monitoring of the deprotonation reactions, which take place with loss of the OH proton. The radicals are relatively acidic; pK/sub a/ is 8.8 for I, 5.5 for II, and 6.5 for III. Second-order rate constants are reported for deprotonation of the radicals by OH^-, NH_3, $B(OH)_4^-$, HPO_4^{2-}, $HP_2O_7^{3-}$, and $P_2O_7^{4-}$. In each case, DELTA G^0 less than 0; Typical rate constants (sec^{-1} M^{-1}) at 22 +- 1^0 are: OH^- + I, 3.9 x 10^9; OH^- + II, 1.1 x 10^{10}; OH^- + III, 1.1 x 10^{10}; NH_3 + I, 7.5 x 10^8; NH_3 + II, 1.2 x 10^9; NH_3 + III, 9.7 x 10^8; $P_2O_7^{4-}$ + I, 5.8 x 10^6; $P_2O_7^{4-}$ + III, 8.5 x 10^5. The rate constants for deprotonation of the radicals are similar to those for deprotonation (with DELTA G^0 less than 0) of stable and of electronically excited oxygen acids. (auth)

8549 PROTONATION REACTIONS OF ELECTRON ADDUCTS OF ACRYLAMIDE DERIVATIVES. A Pulse Radiolytic-Kinetic Spectrophotometric Study. Madhavan, V. (Army Natick Labs., MA); Lichtin, N. N.; Hayon, E. J. Am. Chem. Soc.; 97: No. 11, 2989-2995(28 May 1974).

The absorption spectra of electron adducts of a number of alpha,beta-unsaturated carboxamides and of methyl methacrylate, as well as of two isomeric types of protonated electron adducts, have been characterized by means of the technique of pulse radiolysis-kinetic absorption spectrophotometry. Spectra of the electron adducts are characterized by bands in the uv (epsilon /sub max/ approximately 10^4 M^{-1} cm^{-1}) and in the visible (epsilon /sub max/ approximately 10^3 M^{-1} cm^{-1}). The position of the uv band shifts 10-30 nm to shorter wavelength upon reversible protonation. Fast reversible protonation of electron adducts takes place at the carbonyl oxygen. The pK/sub a/ values of the electron adducts vary linearly with the pK/sub a/ values of the corresponding carboxylic acids: for acrylamide, 7.9; methacrylamide, 8.0; trans-crotonamide, 8.5; beta,beta-dimethylacrylamide, 9.5; N,N-dimethylacrylamide, 8.5; trans-cinnamamide, 7.2; methyl methacrylate, approximately 7. Slower irreversible protonation of the electron adducts takes place at the beta-carbon atom and is subject to general acid catalysis which obeys the Bronsted catalysis law. Uncatalyzed specific rates of beta protonation of anion radicals (in units of 10^5 sec^{-1}) are: for acrylamide, 1.4; for methacrylamide, 13; for trans-crotonamide, 0.22; for beta,beta-dimethylacrylamide, 0.21; for N,N-dimethylacrylamide, 3.7; for trans-cinnamamide, less than or equal to approximately .01; for methyl methacrylate, 4.5. The second-order decay of reversibly protonated electron adducts competes with irreversible beta protonation. (auth)

8550 EXCIMER FLUORESCENCE OF TRANS-STILBENE AND DIPHENYLACETYLENE. Brocklehurst, B.; Bull, D. C.; Evans, M.; Scott, P. M.; Stanney, G. (Univ. of Sheffield, Eng.). J. Am. Chem. Soc.; 97: No. 11, 2977-2978(28 May 1975).

Excimer fluorescence from trans-stilbene (lambda/sub max/ equals 430 nm) and diphenylacetylene (390 nm) is reported. A new method of detecting labile excimers was used: emission spectra were measured on warming solutions in squalane after gamma irradiation at 77°K. Excimers are formed by neutralization of dimer cations and are stabilized against further reaction by the high viscosity. (auth)

8551 EFFECTS OF GAMMA RADIATION ON TWO AROMATIC POLYSULFONES. Brown, J. R. (Australian Defence

Scientific Service, Melbourne); O'Donnell, J. H. J. Appl. Polym. Sci.; 19: No. 2, 405-417(Feb 1975).

Two aromatic polysulfones, poly(oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy-1,4-phenyleneisopropylidene-1,4-phenylene) (I) and poly(oxy-1,4-phenylenesulfonyl-1,4-phenylene) (II), undergo crosslinking and chain scission at 30°C during gamma-irradiation, the former being predominant in vacuum and the latter in air. Both processes occurred more readily in I, which contains isopropylidene linkages. Gel measurements gave G(crosslink) equals 0.051, G(scission) equals 0.012 for this polymer at 30°C in vacuum. Increased irradiation temperatures resulted in higher crosslinking and gas yields, especially above the glass transition temperature. The tensile strength, flexural strength, and modulus of I were unaffected by gamma-irradiation up to about 50 Mrad in air, but the strength decreased markedly at higher doses. The elongation at break decreased progressively with dose. For both polymers, G(gas) equals 0.04 at 30°C with the main products being SO_2, H_2, CO_2, CH_4, and H_2O. (auth)

8552 APPLICATION OF DIFFERENTIAL THERMAL ANALYSIS TO THE STUDY OF TRAPPED INTERMEDIATES PRODUCED IN SIMPLE ORGANIC GLASSES BY GAMMA RADIOLYSIS. Spectrophotometric Investigations of Electron Trapping and Photobleaching in 3-Methylpentane and Methyltetrahydrofuran Glasses. Hager, S. L. Madison, WI; Univ. of Wisconsin (1974). 265p. University Microfilms Order No. 75-7582.

Thesis (Ph. D.).

Gamma radiolysis of simple organic glasses such as 3-methylpentane (3MP) and 2-methyltetrahydrofuran (MTHF) at low temperatures produces trapped electrons (e⁻/sub t/), radicals and molecular ions. The knowledge of these intermediates and of the trapping matrices was extended by spectrophotometric measurements and by differential thermal analysis (DTA), a technique heretofore not applied to the study of radiation processes in simple organic glasses. (JSR)

8553 ELECTRON–ELECTRON DOUBLE RESONANCE INVESTIGATIONS OF IRRADIATED ORGANIC SINGLE CRYSTALS. Chang, K. Birmingham, AL; Univ. of Alabama (1974). 269p. University Microfilms Order No. 75-9890.

Thesis (Ph. D.).

Electron-electron double resonance spectroscopy (ELDOR) is a technique developed recently for unravelling complicated ESR spectra, and hyperfine splittings can be accurately measured. Separation and assignment of ESR lines have been found to be possible when the energy levels of radicals are connected by intramolecular relaxation mechanisms. The electron-nuclear dipolar relaxation mechanism (END) which depends on the nuclear spin quantum number and nuclear gyromagnetic ratio was found to be a predominant intramolecular relaxation mechanism above room temperature for $(CH_3)_2\dot{C}COOH$ in irradiated alpha-aminoisobutyric acid and dimethylmalonic acid and for $\dot{C}H_2COOH$ in irradiated malonic acid crystals. The presence of an intramolecular cross relaxation mechanism simultaneously connecting states of different nuclear and electron spin quantum numbers leads to enhanced ESR signals for $(CH_3)\dot{C}COOH$ in irradiated alpha-aminoisobutyric acid and dimethylmalonic acid crystals below room temperature. Enhanced ESR spectra were also observed for $\dot{C}F_2CONH_2$ below room temperature and for irradiated glycine above room temperature. A large variation in intensity of the allowed and forbidden ELDOR lines for $\dot{C}H_2COOH$ and $\dot{C}H_2COO^-$ in irradiated malonic acid and zinc acetate crystals, respectively, was found to be due to an inter-J coupling relaxation mechanism induced by the interchange of the two protons. In $\dot{C}FHCONH_2$ the fluorine p-orbital anisotropy is the dominant intramolecular relaxation. However, the p-orbital anisotropy is dominated by the rotational motion in $\dot{C}F_2CONH_2$. Quadrupole relaxation mechanism of the chlorine nucleus was found to be dominant over all other relaxation processes for $\dot{C}ClHCONH_2$, $\dot{C}ClFCONH_2$, $\dot{C}Cl_2CONH_2$ and $\dot{C}Cl_3$. The importance of cross relaxation mechanism for $^{15}\dot{N}H_3^+\dot{C}HCOO^-$ and of END relaxation mechanism for $\dot{C}H_2COO^-$ enabled identification of each ESR line for the two radicals trapped in irradiated ^{15}N-glycine crystals. A large decrease in the deuterium ELDOR line intensity as a result of an END relaxation mechanism permitted the investigation of three H–D exchange reactions in irradiated glycine-d_3. (Diss. Abstr. Int., B)

8554 ELECTRON–ION RECOMBINATION RATE CONSTANTS FOR SOME COMPOUNDS OF MODERATE COMPLEXITY. Maier, H.N.; Fessenden, R.W. (Radiation Research Laboratories and Department of Chemistry, Mellon Institute of Science, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 62: No. 12, 4790-4795 (15 June 1975).

Electron–ion recombination has been studied for the systems N_2, CH_4, C_3H_8, neopentane, NH_3, and CO_2 by use of a microwave conductivity method coupled with pulse radiolysis. Rate constants were determined by analysis of the directly observed electron disappearance. All data pertain to 297°K. Corrections were made for competing electron losses by extrapolation to zero of a plot of apparent second-order rate constant versus reciprocal of initial electron concentration. No attempt was made to try to identify the positive ions present. The rate constants for the first four compounds showed little change with pressure over the range 1–100 torr with the value found at 100 torr about 20%–50% higher than that at 1 torr. Values for pressures of 10–50 torr are 2.5×10^{-6} for N_2, 3.9×10^{-6} for CH_4, 5.8×10^{-6} for C_3H_8, and 4.2×10^{-6} for neopentane (all cm^3 $molecule^{-1}$ $\cdot sec^{-1}$). The values found for NH_3 varied from 4.6×10^{-6} at 1 torr to 11.2×10^{-6} at 10 torr. Data for CO_2 were less reliable but showed a change of from 4×10^{-6} at 1.5 torr to 11×10^{-6} at 100 torr. (auth)

8555 CHEMICALLY INDUCED DYNAMIC ELECTRON POLARIZATION. PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS OF ALCOHOLS. Trifunac, A.D.; Thurnauer, M.C. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 62: No. 12, 4889-4895 (15 June 1975).

The radical pair model of chemically induced dynamic electron polarization (CIDEP) is experimentally verified. Aqueous solutions of alcohols were irradiated with 3 MeV electrons and observed with time resolved electron paramagnetic resonance (EPR) spectroscopy. Relative line intensities of the polarized EPR spectra of radicals from methanol and especially ethylene glycol, alone and in the presence of radicals from compounds containing halogens, illustrate the polarization dependence on the g-factor differences between the radical pair components. The observation of the relative polarization enhancement in the various lines of the multiline EPR spectra illustrates the polarization dependence on the hyperfine terms. Intrinsic enhancements are calculated and are shown to be proportional to the observed enhancement, showing that the radical pair model of CIDEP is qualitatively correct. (auth)

8556 REDOX POTENTIALS OF FREE RADICALS. III. REEVALUATION OF THE METHOD. Rao, P. S.; Hayon, E. (Army Natick Labs., MA). J. Am. Chem. Soc.; 97: No. 11, 2986-2989(28 May 1974).

A reevaluation of the method described in ref 1 and 2 to determine the redox potentials of free radicals (·RH) in water using the techniques of pulse radiolysis and absorption spectrophotometry is presented. This method is based on the dependence of the percentage efficiency for the one-electron oxidation (or reduction) of ·RH radicals on the redox potentials E^{01} of the electron acceptors, A. The reaction ·RH + A yields $\cdot A^- + R + H^+$ (kappa/sub ox/) is not reversible for most radicals under the experimental conditions used, and the derived potentials are, therefore, not thermodynamic values. A reinterpretation of the results is made on the basis of the kinetic competition between the above reaction and ·RH + A yields ·RHA (kappa/sub add/) (radical adducts). Based on kappa/sub ox/ and kappa/sub add/, it is concluded that the observed experimental "titration" curves do represent a measure of the redox property of the free radicals. From the midpoint on the curves, the kinetic potential, E/sub kappa/^{01}, of the free radicals can be derived based on the known two-electron redox potentials of the electron acceptors. These and other questions are discussed. (auth)

8557 DEVELOPMENTS IN RADIATION-INDUCED GRAFT POLYMERIZATION TO CELLULOSICS. Guthrie, J. T. (Univ. of Leeds, Eng.). Polymer; 16: 134-150(Feb 1975).

The review is presented under the following headings: techniques of radiation-induced grafting (pre-irradiation method–including a table showing recent developments; and simultaneous irradiation technique–also including tabulated data); kinetics of the grafting reaction; effects of high energy radiation on cellulose (cellulose degradation, electron spin resonance spectroscopy); intramolecular energy transfer in celluloses; copolymer characterization (solution properties, morphological properties); applications of radiation-induced cellulose grafting; radiation-induced grafting to wood; recent patent literature. (UK)

8558 THERMOLUMINESCENCE OF SOLUTIONS IN SQUALANE AFTER γ-IRRADIATION. Brocklehurst, B.; Bull, D. C.; Evans, M. (Univ. of Sheffield, Eng.). J. Chem. Soc. (London), Faraday Trans., II.; 71: No. 3, 543-554(1975).

The isothermal luminescence and thermoluminescence of squalane and its solutions has been studied following irradiation with γ-rays at 77°K. The main solute used was biphenyl which gives excimer fluorescence under these conditions as well as monomer emissions. The luminescence is ascribed to ion recombination. It is only necessary to postulate two kinds of electron trapping, in the solvent or as solute anions, but there are five recombination processes giving glow peaks. If electron-attaching solutes are absent, the dominant process is thermal release of trapped electrons at ~100°K. In solutions of biphenyl most electrons form anions; these recombine with biphenyl cations when large molecules become mobile at the glass transition (~180°K). Close ion pairs can also decay by electron tunnelling: this produces the isothermal luminescence at 77°K. At intermediate temperatures, there is a peak ascribed to thermally

assisted tunnelling; this process becomes predominant at very high concentrations. Oxygen appears to act as a carrier of electrons between anions and cations, giving an extra peak, with a high proportion of phosphorescence, below the glass transition. Carbon dioxide and sulphur hexafluoride also have striking effects on the glow-curves. Scavenging at 77°K can be distinguished from scavenging in the melting glass. (auth)

8559 GAMMA-RAY INDUCED LUMINESCENCE OF SILICA GEL. I. Thermoluminescence and the Effect of Adsorbed Molecules. Kirmaier, P.; Rabe, J. G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Sektor Strahlenchemie). Z. Naturforsch., A; 30: No. 2, 161-169(Feb 1975).

The thermoluminescence glow curve of γ-irradiated silica gel investigated between 77 and 600°K is a broad band extending from 80°K to approximately 400°K. The emission occurs at approximately 450 nm. Shallow traps (0.1 to 0.2 eV) are responsible for most of the light emitted. The distribution of trap depth and the increase of trap density toward the band edge is tentatively attributed to the disordered structure of silica gel in accordance with previous suggestions concerning glasses. In contrast to the growth with radiation dose of color- and paramagnetic center concentration, luminescence is already saturated at about 1 Mrad. The luminescence decay follows the hyperbolic relation derived by Adirowich for a bimolecular process. Removal of surface OH groups as accomplished by raising the degassing temperature of the gel results in an increase of luminescence intensity by several orders of magnitude. (GE)

8560 GAMMA-RAY INDUCED LUMINESCENCE OF SILICA GEL. II. Luminescence Occurring on Adsorption of Gases: Radiosorptionluminescence. Breitkreutz, K.; Kirmaier, P.; Rabe, J. G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Sektor Strahlenchemie). Z. Naturforsch., A; 30: No. 2, 170-174(Feb 1975).

Luminescence observed on adsorption of gases and vapors (RSL) on silica gel previously exposed to γ-rays was investigated. The dependence of RSL intensity on absorbed radiation dose and degassing temperature of the gel prior to irradiation parallels the dependence of radiothermoluminescence (RTL) intensity. A limiting value is reached around 1 Mrad and the intensity increases steeply on raising the degassing temperature. The RSL intensity is largest on adsorption of H_2 and decreases in the order H_2; O_2; N_2O; N_2; He. The stronger the RSL effect, the more is the subsequent measured RTL reduced. The RSL emission spectrum has a maximum at 450 nm and is identical with the spectrum of RTL. (GE)

8561 EPR OF RADIATION DAMAGE CENTERS IN $NaNO_3$, $Sr(NO_3)_2$, BaS, AND $MgC_2O_4 \times 2H_2O$. Koeksal, F.; Yueksel, H. (Ankara Univ. (Turkey). Dept. of Physics). Z. Naturforsch., A; 30: No. 2, 269-270(Feb 1975).

$NaNO_3$, $Sr(NO_3)_2$, BaS, and $MgC_2O_4 \times 2H_2O$ powders were γ-irradiated at room temperature and their electron spin resonance spectra examined for paramagnetic species. The species identified were NO_3 and NO_2 radicals in the nitrates, SO_2^- and S in BaS, and $H_2C_2O_4^-$ in magnesium oxalate. Theoretical predictions agree with these assignments. (auth)

8562 SEWAGE SLUDGE-STERILIZATION BY MEANS OF GAMMA RAYS. Ind.-Anz.; 96: No. 94, 2114-2115(1974). (In German).

A method is described using a ^{60}Co gamma source for the destruction of morbific agents in sewage sludge. The such processed sludge may be used in agriculture as fertilizer without any hesitation. (GE)

8563 PHOTOCHEMISTRY AND RADIATION CHEMISTRY OF SULFUR-CONTAINING AMINO ACIDS. A New Reaction of the 1-Propenylthiyl Radicals. Nishimura, H.; Mizutani, J. (Hokkaido Univ., Sapporo). J. Org. Chem.; 40: No. 11, 1567-1575 (30 May 1975).

In connection with food-flavor deterioration caused by uv or gamma irradiation, a new reaction of the 1-propenylthiyl radicals from S-(cis-1-propenyl)-L-cysteine irradiated by uv ray or gamma-ray in oxygen-free aqueous solutions was investigated. The main products, formed via 1-propenylthiyl radicals, in uv photolysis were 1-propene-1-thiol, 2,4-dimethylthiophene, 3,4-dimethylthiophene, and 3-methylthiophene, while gamma radiolysis yielded 1-propene-1-thiol, n-propyl 1-propenyl sulfide (cis and trans), and di-1-propenyl sulfide (cis,cis and cis,trans). Furthermore, cis-trans isomerization of 1-propenylthiyl radicals plays an important role in the formation of these products. (auth)

8564 DECOMPOSITION OF ALDRIN BY GAMMA RADIATION. II. In Lipid Solutions. Carp, A. E.; Liska, B. J.; Ziemer, P. L. (Purdue Univ., Lafayette, IN). Bull. Environ. Contam. Toxicol.; 7: No. 6, 331-337(Jun 1972).

Aldrin was dissolved in corn oil and lard and exposed to gamma irradiation at absorbed doses up to 6,0 Mrad under various conditions: without any temperature control and at -196°C, air-packed and nitrogen-packed, stored in the dark after irradiation at room temperature and at -20°C. An analysis of the gas chromatograms of the irradiated samples showed that the irradiation temperature was the only factor with significant effects on the amount of degradation products. Less aldrin was degraded during irradiation at -196°C. The ratio of the two peaks on the chromatogram representing degradation products was affected by the gaseous atmosphere in samples irradiated at -196°C and stored at room temperature. (JSR)

8565 EPR OF LOW SPIN d^7 Fe^+, Co^{2+}, AND Ni^{3+} CYANIDE COMPLEXES IN NaCl AND KCl. Jain, S.C.; Reddy, K.V.; Reddy, T.R. (Solid State Physics Laboratory, Lucknow Road, Delhi-110007, India). J. Chem. Phys. 62: No. 11, 4366-4372 (1 June 1975).

Low spin d^7 complexes of type $[M(CN)_4 \cdot XY]^{n-}$, where M is Fe^+, Co^{2+}, or Ni^{3+}, the axial ligands X, Y being Cl^-, CN^-, or NC^-, have been produced and stabilized in NaCl and/or KCl crystals doped with diamagnetic $Fe(CN)_6^{4-}$ (d^6), $Co(CN)_6^{3-}$ (d^6) or $Ni(CN)_4^{2-}$ (d^8), by a suitable combination of irradiation and heat treatment. These complexes were identified by EPR on the basis of the g factors which are characteristic of unpaired electrons in the d_{z2} orbital pointing towards the ligands X and Y, and the super hyperfine structure from the nuclei of these ligands observed in the EPR spectra. Systematic variations are noted in the EPR parameters, which are discussed in terms of changes in the nature of binding in these complexes in relation to the charge state of the metal ion, the host lattice spacings, and the nature of the axial ligands. In addition to showing that CN^- and NC^- are much stronger ligands than Cl^-, the study pointed out the importance of back bonding in CN^-- and NC^--type ligands. (auth)

8566 ON THE SPECIFIC RATES FOR ELECTRON SCAVENGING IN NONPOLAR SOLVENTS. Funabashi, K.; Magee, J.L. (Department of Chemistry and the Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 62: No. 11, 4428-4435 (1 June 1975).

An attempt is made to formulate a theory of the reaction rate constant for electron scavenging which is valid for high mobility nonpolar liquids. It is proposed that the scavenging mechanism is an electron capture process which is completely analogous to the gas phase process. Application to the liquid state of theory developed for the use in the gas phase requires careful consideration of the relative energies of the quasifree (i.e., V_0) and captured states of the electron and it is shown that a reasonable conjecture (that the polarization energy of a scavenger negative ion is the same in all hydrocarbons) allows a semiquantitative correlation of the known experimental results. When the energy of the negative-ion state of the scavenger in the Franck–Condon region is above the V_0 level (e.g., C_2H_5Br in TMS), the reaction rate is shown to increase with V_0, while if the former is below the V_0 level (e.g., CCl_4 in neopentane), the reaction rate decreases with V_0. The temperature dependence of the observed rates is qualitatively consistent with the proposed model. (auth)

8567 EPR STUDIES OF X—RAY IRRADIATED KH_2AsO_4 AND KH_2PO_4-TYPE FERROELECTRICS AND ANTIFERROELECTRICS. Dalal, N.S.; Hebden, J.A.; McDowell, C.A. (Department of Chemistry, The University of British Columbia, Vancouver, British Columbia V6T 1W5, Canada). J. Chem. Phys. 62: No. 11, 4404-4410 (1 June 1975).

EPR has been used to characterize the hyperfine couplings and electronic structure of a new paramagnetic center $(H_2AsO_4)^{2-}$ in x-irradiated ferroelectric crystals of pure KH_2AsO_4 and mixed KH_2PO_4–KH_2AsO_4, and antiferroelectric mixed crystals of $NH_4H_2PO_4$–$NH_4H_2AsO_4$, $NH_4H_2PO_4$–KH_2AsO_4, and $ND_4D_2PO_4$–KD_2AsO_4. This center is formed by the capture of an electron by proton deficient AsO^{3-}_4 units in these crystals. The assignment of the center is supported by EPR studies on the temperature dependence of the proton superhyperfine structure of these crystals. The present study also corrects an earlier identification of this center in $NH_4H_2PO_4$–KH_2AsO_4 as a hole-type ionic defect center AsO^{2-}_4. Our results also provide a direct experimental basis for the currently accepted model of electrical (protonic) conduction in these crystals and help to resolve an earlier controversy regarding conductivity measurements on sulfate-doped ammonium and potassium salts. In conjunction with x-ray photoelectron spectroscopic studies, the EPR results on doped crystals also provide interesting results on electron-capture processes in single crystals. The present work also provides an explanation of some anomalous trends of the hyperfine coupling variation in other XO_4-type radicals. (auth)

8568 SOLVATED ELECTRON YIELDS IN PULSE-IRRADIATED LIQUID 1-PROPANOL. Dixon, R.S.; Lopata, V.J. (Research Chemistry Branch, Whiteshell Nuclear Research Establishment, Pinawa, Manitoba, Canada R0E 1L0). J. Chem. Phys. 62: No. 11, 4573-4574 (1 June 1975).

The optical absorption spectrum of the solvated electron in 1-propanol

and its decay at various temperatures following a pulse of electrons have been studied, and the relative yields of geminate and free solvated electrons have been obtained. From these, the absolute yields have been estimated over the temperature range 150–298 K. (AIP)

8569 ELECTRONIC QUENCHING AND VIBRATIONAL RELAXATION OF THE OH ($A\,^2\Sigma^+$, $v'=1$) STATE. Hogan, P.; Davis, D.D. (Chemistry Department, University of Maryland, College Park, Maryland 20742). J. Chem. Phys. 62: No. 11, 4574-4576 (1 June 1975).

Rate constants for electronic quenching and vibrational relaxation of the $v'=1$ manifold of ($A\,^2\Sigma^+$) OH by Ar, H_2, N_2, and He have been obtained by a laser fluorescence method. The quenching rate constants for $v'=1$ are not appreciably different from those which have been measured for $v'=0$. The relaxation rate constants are a factor of 3 larger than the quenching rate constants for Ar and H_2, and 5 times larger for nitrogen. (AIP)

8570 ION PAIR FORMATION IN CF_4. Ahnell, J.E.; Koski, W.S. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218). J. Chem. Phys. 62: No. 11, 4474-4476 (1 June 1975).

A careful search has been made for the ion pair process $CF_4 + e \rightarrow CF_3^+ + F^- + e$ in the electron bombardment of CF_4 using a coincidence mass spectrometer with near monochromatic electrons. A weak but easily detectable ion pair process was observed with a threshold in the neighborhood of 12 eV. In addition, a low level of CF_3^+ ions was observed below the ionization potential of CF_3. This was attributed to the ionization of excited CF_3 radicals. (auth)

8571 STUDY OF MOLECULAR MOTION IN POLYMERS USING EPR SPECTRA OF "NEXT NEAREST" RADICAL PAIRS. Bel'kova, L. P.; Lebedev, Ya. S. (Inst. of Chemical Physics, Moscow). Vysokomol. Soedin., Ser. A; 17: No. 2, 324-328(Feb 1975). (In Russian).

It is shown that study of the annealing of radical pairs by EPR spectra of "forbidden" transitions $\Delta M_s = 2$ in irradiated polymers is a very sensitive method of disclosing and studying structural conversions. Patterns of annealing radicals and "close" pairs demonstrated for polyethylene and polyoxymethylene suggest a qualitative model for low-temperature reactions of annealing of radicals in crystalline polymers. (tr-auth)

8572 EVIDENCE FOR REDUCTIVE RADIOLYTIC DEPHOSPHORYLATION IN THE NUCLEOTIDE ANALOGUE 8,5′-CYCLOADENOSINE-5′-MONOPHOSPHATE. Raleigh, J. A.; Whitehouse, R. (Atomic Energy of Canada, Ltd., Pinawa, Manitoba). J. Chem. Soc. (London), Chem. Commun.; No. 9, 305-306 (7 May 1975).

Evidence is presented that hydrated electrons efficiently induce phosphate release from the nucleotide analogue 8.5′-cycloadenosine 5′-monophosphate; hydrogen atoms are ineffective in this process. (auth)

8573 RADIATION-INDUCED ALIPHATIC HYDROGEN EXCHANGE IN AQUEOUS SOLUTION: EVIDENCE FOR A SPUR REACTION BETWEEN ORGANIC RADICALS AND ELECTRONS. Gold, V.; McAdam, M. E. (King's Coll., London). J. Chem. Soc. (London), Chem. Commun.; No. 6, 228-229(19 Mar 1975).

Stereochemical studies on cyclohexane-1,2-diols and scavenger experiments on dioxane indicate that the radiation-induced hydrogen exchange at C–H bonds involves the reaction sequence: $RH \xrightarrow{OH^-} R^\cdot \xrightarrow{e^-_{aq}} R^- \xrightarrow{HTO} RT$, the first two steps of which occur in spur regions. (auth)

8574 ELECTRIC CONDUCTIVITY OF PHOSPHATE- AND AgCuSe/As_2Se_3-GLASSES AFTER RADIATION INDUCED CHEMICAL REACTIONS. Kolditz, L.; Maetzing, H. D. (Humboldt-Univ., Berlin (German Democratic Republic). Sektion Chemie). Z. Chem.; 14: No. 10, 414-415(1974). (In German).

Chemical radiation effects induced by ^{60}Co γ rays are reported. The results are compared with those obtained by x radiation. Temperature dependence of conductivity and activation energies are given. (INIS)

Radiochemistry and Nuclear Chemistry

Hot-Atom Chemistry

Refer also to abstract 8514.

8575 (CRN-CNPA-74-28) CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS; BIBLIOGRAPHY 1973. Adloff, J. P. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). 1974. 40p. INIS.

A bibliography on hot atom chemistry was compiled for the year 1973 with some comments on a Decadal bibliography on the same subject. (FR)

8576 RADIATION DAMAGE IN TRANSITION METAL HEXAHALO COMPLEXES: THE APPLICATION OF ATOMIC COLLISION DYNAMICS IN HOT ATOM CHEMISTRY. Roessler, K. (Kernforschungsanlage, Juelich, Ger.); Robinson, M. T. pp 237-249 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). CONF-730958-P1.

In transition metal hexahalo complexes $K_2[MeX_6]$, the chemical consequences of "hot" atom reactions can be observed in relatively simple systems. The primary recoils, generated by nuclear reactions or implanted as radioactive ions, can be studied by radiochemical methods. The halogen recoils may appear either as free halide $^*X^-$ or as labeled complex anion $[MeX_5{}^*X]^{2-}$. The hot atom chemistry of these systems can be accounted for in largely solid state physical terms, using computer simulation techniques. In general, excellent agreement between the experimental data and the model calculations can be obtained using reasonable model parameters. This agreement shows that the product distribution in these systems is controlled by atomic collision dynamics and simple reactions of a well-defined number of simple defects. (5 figs, 4 tables, 24 refs) (auth)

Properties of Radioactive Materials

Refer also to abstracts 8893, 9297, 9320, 9371, 10752, and 11097.

8577 (BNWL-B-378) SOLUBILITY OF ELEMENTS IN U. S. WESTERN DESERT GROUND WATER AND COMPARISON WITH CHEMICAL AND RADIOLOGICAL CONCENTRATION LIMITS FOR DRINKING WATER. Card, T. R.; Jansen, G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1975. Contract AT(45-1)-1830. 53p. Dep. NTIS $5.45.

The solubilities for 96 elements in typical western U.S. desert ground water were estimated along with the degrees of reliability of the estimate for each element. Because of the many simplifying assumptions needed in this evaluation, the results should be used only for preliminary screening purposes or for demonstrating the utility of the methodology. The major insoluble chemical species were hydroxides (44 elements), carbonates (11 elements), sulfates (5 elements) and anionic or nonionic forms (19 elements). Comparison of the solubilities of the elements with drinking water limits for chemicals indicates that 23 elements may not be soluble enough in ground water to reach chemically toxic limits. These elements include radioisotopes of C, Co, Zr, Ru, Pd, Sn, Pb, Th, U, Pu, and Am found in high-level wastes. Comparison of the solubilities of radionuclides with the 10CRF20 Recommended Concentration Guide for radionuclides in drinking water shows that the major long-lived isotopes of Zr, Pd, Sn, Th, U, and possibly Pu may be too insoluble in drinking water obtained from the ground water supply to become a radiological hazard from buried waste. A few radionuclides such as Pd-107, Th-232, U-235, U-238 and possibly Pu-242 found in high-level wastes may reach chemically toxic concentrations in drinking water before 10CFR20 radionuclide limits are exceeded. If isotopic dilution of several radionuclides by factors up to 10,000 could be achieved, the radiological hazard might be decreased below 10CFR20 limits in buried waste by lowering the radioactivity of ground water saturated in that chemical element. This isotopic dilution might be expected to occur naturally over long travel paths within geologic formations or might be introduced by isotopically diluting stored waste itself. (auth)

8578 (FRNC-TH-536) STUDY OF THE PHOTOREDUCTION OF URANYL PERCHLORATE BY ETHANOL UNDER MONOCHROMATIC IRRADIATION OF WAVELENGTH 404.7-407.8 nm AND UNDER POLYCHROMATIC IRRADIATION. Feve, M. (Lyon-1 Univ., 69 (France)). 1974. 134p. (In French). INIS.

An apparatus was designed and built for the kinetic study of uranyl perchlorate photoreduction by ethanol. It allows the uranium (IV) and uranium (V) concentrations to be followed simultaneously during the reaction by physical measurements carried out in a carefully deoxygenated cell. This apparatus was used to determine the influence of the following parameters: temperature, absorbed light intensity, and concentrations of the reagents UO_2^{++}, H_3O^+, ethanol on the photochemical kinetics of uranium (IV) and uranium (V) appearance and on the kinetics of uranium (V) disappearance in darkness. A mechanism is proposed, taking into account all the experimental facts observed under monochromatic irradiation of wavelength 404.7-407.8 nm and also during polychromatic illumination by the high-pressure mercury vapor lamp. Published data concerning each stage of this mechanism are discussed. (FR)

8579 (N-74-34580) PLASMA SPECTROSCOPY OF URANIUM AND TUNGSTEN. Part 1. Final Report. Wilkerson, T. D. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Aug 1973. 7p. (NASA-CR-121240; BN-801-Pt-1). NTIS $4.00.

Results of research on uranium and tungsten spectra are summarized. Measurements of visible line spectra and opacities were carried out on shock tube plasmas which, prior to shock compression, were mixtures of rare gases and UF_6 or WF_6. Opacities were compared to theoretical predictions. Feasibility of light source methods other than the shock tube was explored for future applications in the spectroscopy of heavy metals and ions. (auth)

8580 (UCID-16799) HEAT OF FORMATION OF PLUTONIUM HYDRIDES. Colmenares, C.; Alexander, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 May 1975. Contract W-7405-Eng-48. 12p. Dep. NTIS $4.00.

The heat of formation of PuH_3 at 298°K was studied by using thermogravimetric techniques combined with pressure measurements of the equilibrium partial pressure of hydrogen over the hydride. The results confirmed the value of −46.1 ± 0.1 kcal/mole reported by Ivanov and Podol'skaya. (LK)

8581 SYNTHESIS AND COMPLEX-FORMATION PROPERTIES OF N−2(HYDROXYETHYL)ETHYLENEDIAMINE−N, N', N'-TRISMETHYLENETRISPHOSPHONIC ACID. Kireeva, A. Yu.; Rudomino, M. V.; Dyatlova, N. M. J. Gen. Chem. USSR; 44: No. 12, 2594-2597(Dec 1974).

Translated from Zh. Obshch. Khim.; 44: No. 12, 2637-2641(Dec 1974).

Two methods were developed for the synthesis of the new organophosphorus sequestering agent: N-(2-hydroxyethyl)ethylenediamine-N,N',N'-trismethylenetrisphosphonic acid. Dissociation constants of the acid and stability constants of its complexes with a number of cations were determined. The sequestering agent behaves selectively toward the iron(III) ion. (auth)

8582 SIGMA- VS. pi-BONDED ORGANOACTINIDES. The Synthesis and Structural Analysis of Tris(eta^5-Cyclopentadienyl)-eta^1-2-Methylallyluranium(IV). Halstead, G. W.; Baker, E. C.; Raymond, K. N. (Univ. of California, Berkeley). J. Am. Chem. Soc.; 97: No. 11, 3049-3052(26 May 1974).

The synthesis, characterization, and structural analysis of the title compound, $(C_5H_5)_3[CH_3C(CH_2)_2]U$/sup IV/, is reported. The reaction of $U(C_5H_5)_3Cl$ with $Mg[CH_3C(CH_2)_2]Cl$ under inert atmosphere conditions at −78°C in THF gives a high yield of the uranium allyl. Slow recrystallization gives dark red-brown crystals. The structure has been determined from three-dimensional x-ray diffraction data collected by counter methods. Three pi-bonded eta^5-cyclopentadienide rings are bonded to the uranium atom with an average bond distance of 2.74(1) A. A sigma-bonded eta^1-2-methylallyl group completes the coordination sphere with a U−C bond length of 2.48(3) A. The coordination geometry is a distorted tetrahedron with approximate C/sub 3v/ symmetry. The average (center of cyclopentadienide ring)−U−(allyl carbon) bond angle is 100°. A sigma-bonded ground state geometry vs. the pi-bonded geometry observed in $(C_5H_5)_4U$ is explained by the competition between the reorganization energy and the increase in coordinate bonds on going from the sigma- to pi-bonded complexes. The crystals conform to space group $P2_12_12_1$ with a equals 10.240 (4), b equals 8.747 (4), c equals 18.198 (4) A, Z equals 4, and rho/sub calcd/ equals 1.99 g/cm^3. A total of 3470 reflections were collected of which 1698 independent reflections with F^2 equal to or greater than 3 sigma (F^2) were used in the final refinement by full-matrix least-squares methods to give weighted and unweighted R factors of 6.4 and 6.5 percent, respectively. (auth)

8583 X-RAY CRYSTAL AND MOLECULAR STRUCTURE OF UCl_4-3Me_2SO: DICHLOROHEXAKIS(DIMETHYL SULPHOXIDE)URANIUM HEXACHLOROURANATE $[UCl_2(Me_2SO)6][UCl_6]$. Bombieri, G.; Bangnall, K. W. (Consiglio Nazionale delle Ricerche, Padua). J. Chem. Soc. (London), Chem. Commun.; 188-189(19 Mar 1975).

In the title compound the uranium atom in the cation is dodecahedrally coordinated and that in the anion is octahedrally coordinated. (auth)

8584 CONTINUOUS FLUID BED REACTOR FOR FISSIONABLE MATERIAL. Ziegler, D. L. (to U.S. Atomic Energy Commission). US Patent 3,869,256. B01j1/00; C01g56/00. 4 Mar 1975. Filed date 28 Sep 1972. 7p.

PAT-APPL-293,177.

Plutonium (Pu) purification and plutonium hexafluoride (PuF_6) formation are achieved on a continuous basis by feeding particulate material into one end of an elongated and horizontally disposed vessel having an upper section with generally converging side walls and a lower section with generally vertical side walls, compartmented throughout its length by transversely disposed baffles, so that particulate material flows through the vessel in vertical generally zigzag fashion, being fluidized by dispersing gas that enters the compartment from a lower narrow compartment and discharges through an upper widened compartment. Vaporous PuF_6 formed from a reaction between the dispersing gas and the particulate material discharges through the upper widened compartment and solid impurities discharge for collection through a port at a far or distal end of the elongated vessel. (auth)

8585 LABELLED TROPANE ALKALOIDS. VI. Syntheses of [N-methyl-T_1] psicain-neu and of polytopically tritiated psicain. Werner, G.; Stoerr, K. H. (Max-Planck-Institut fuer Hirnforschung, Frankfurt am Main (F. R. Germany). Arbeitsgruppe Neurochemie). Ann. Chem.; No. 10, 1650-1654(1974). (In German).

2 figs.; 12 refs. Part of a thesis by K. H. Stoerr.

The reaction of norpsician-neu with CTH_2I yielded [N-methyl-T_1] psicain-neu, isolated as hydrochloride (activity 51.65 mCi/mmol). Polytopic tritiation of psicain by a modified Wilzbach method yielded a product that was also isolated as hydrochloride with an activity of 30.8 mCi/mmol. The distribution of tritium in [^{3}H] psicain in the benzoic acid, in the pseudoecgonine, and in the CH_3O group was 84.5:11.5:4 per cent. (auth)

8586 SYNTHESIS OF RADIOACTIVE METALLOCENES WITH ^{59}Fe, ^{103}Ru, AND ^{191}Os. Langheim, D.; Wenzel, M.; Nipper, E. (Freie Univ. Berlin (F. R. Germany). Isotopen-Abteilung). Chem. Ber.; 108: No. 1, 146-154(1975). (In German).

By heating inactive ferrocene derivatives with radioactive metall halides, i.e. $^{103}RuCl_3$, radioactive metallocenes are synthesized with yields between 5 and 70% with $^{103}RuCl_3$ or $^{59}FeCl_3$ and nearly 1% with $^{191}OsCl_4$. The radioactive metallocenes can be separated easily from radioactive by-products by TLC. (auth)

8587 FORMATION OF LIQUID DROPS WITH UNIFORM AND CONTROLLED DIAMETERS AT RATES OF 10^3 TO 10^5 DROPS PER MINUTE. Haas, P. A. (Oak Ridge National Lab., TN). AIChE (Am. Inst. Chem. Eng.) J.; 21: No. 2, 383-385(Mar 1975).

The sol-gel processes for preparing small Th, U, and Th–U oxide spheres are based on the conversion of colloidal oxide sol drops into gel spheres by extraction of water into an alcohol. A procedure for the preparation of ThO_2 sol drops, based on the operation of a two-fluid disperser with vibration, was used to prepare batches of 10^6 to 10^8 ThO_2 microspheres on a routine basis. Size distributions of the products were carefully measured by screen and radiographic analyses. (JSR)

8588 KHIMIYA PLATINOVYKH I TYAZHELYKH METALLOV. (Chemistry of Platinum Metals and Heavy Metals). Zhavoronkov, N. M. (ed.). Problems of Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1975). 206p.

A collection of nine review articles extending the concepts of I. I. Chernyaev on coordination chemistry is compiled. The topics discussed are the synthesis and intrasphere conversion of ligands of complex compounds of Pt and Pt metals. Studies on the complex compounds of tetra and hexavalent U and Th and on the crystallochemistry of uranyl complex compounds are also included. Separate abstracts were prepared for four of the articles. (JSR)

For abstracts of individual chapters see: 8589–8592.

8589 INTRASPHERICAL SUBSTITUTION REACTION INTETRAACID URANYL COMPOUNDS. Shchelokov, R. N. pp 110-126 of Khimiya Platinovykh I Tyazhelykh Metallov. Zhavoronkov, N. M. (ed.). Moscow; Izdatel'stvo Nauka (1975). (In Russian).

By the synthesis of multiple mixed uranyl compounds from reactions of tetraacid complexes (primarily oxalates) the effectiveness of a series of mutual ligand substitutions for the determination of the direction of the intraspherical substitution in uranyl compounds was demonstrated. It was shown that this series represents the regularity of the ligand substitution in uranyl compounds and related complexing agents. (45 references) (tr-auth)

8590 CRYSTALLOCHEMISTRY OF URANYL COORDINATION COMPOUNDS. Mikhailov, Yu. N. pp 127-160 of Khimiya Platinovykh I Tyazhelykh Metallov. Zhavoronkov, N. M. (ed.). Moscow; Izdatel'stvo Nauka (1975). (In Russian).

The regularities in the stereochemistry of different classes of uranyl compounds were examined. The structure characteristics of the coordination polyhedron of U(VI) are discussed as a function of the coordination number and ligand specifics in the equatorial plane and as a function of the stoichiometric properties of the compound. The basis of the discussion was x-ray structural and neutron radiographic studies. (99 references) (tr-auth)

8591 COORDINATION COMPOUNDS OF TETRAVALENT URANIUM. Bolotova, G. T. pp 161-178 of Khimiya Platinovykh I Tyazhelykh Metallov. Zhavoronkov, N. M. (ed.). Moscow; Izdatel'stvo Nauka (1975). (In Russian).

The principles of the coordination approach to known compounds of U(IV) synthesizable from aqueous solution are examined. The complex acid compounds are represented in the form of a genetic series in which the members of the series are related by mutual conversions and the U maintains a constant or almost constant coordination number. Usually these series contain from four up to eight monodentate singly charged ligands and a corresponding number of neutral and polydentate ligands. The singularities of the complex formation of U(IV) with the anions of strong and weak acids and the regularities of the formation and properties of mixed complexes were examined. The uniqueness of the chemical behavior of U(IV) in non-aqueous solution was demonstrated with examples of foreign work of recent years. The unique characteristics discussed are decrease of the coordination number, formation of complexes with ligands untypical for U, bonding by N, S, P, As, and C atoms, and covalent character of compounds with some organic radicals. (40 references) (tr-auth)

8592 COMPLEX COMPOUNDS OF THORIUM. Molodkin, A. K. pp 179-203 of Khimiya Platinovykh I Tyazhelykh Metallov. Zhavoronkov, N. M. (ed.). Moscow; Izdatel'stvo Nauka (1975). (In Russian).

The characteristics of Th as a central atom and the singularities of the stereochemistry of the complex compounds formed by it are examined. On examples of sulfate, carbonate, oxalate, formate, acetate, nitrate, and thiocyanide complexes and also on complexes containing neutral molecules (carbamide, dimethyl sulfoxide, and alkyl amines) it was shown that Th is an active atom acceptor. The coordination number in Th complexes can have a value from 4 to 14. The tendency to higher coordination numbers is one of reasons for the polymerization of Th compounds. (tr-auth)

8593 THORIUM: PHYSICO-CHEMICAL PROPERTIES OF ITS COMPOUNDS AND ALLOYS. Kubaschewski, O. (ed.). At. Energy Rev.; No. 5, 1-241(1975).

A critical evaluation and tabulation of the latest and most significant data is presented in six articles on the thermodynamic properties of Th and its alloys and compounds, alloy phase diagrams, crystal structure and density of alloys, halides, and chalcogenides, and diffusion of C in Th and of impurities in ThO_2. Extensive bibliographies are appended to each article. (auth)

8594 VIBRATIONAL ANALYSIS OF THE URANIUM HEXACHLORIDE SPECIES IN OXIDATION STATES OF IV, V, AND VI. Shamir, J.; Silberstein, A.; Ferraro, J. R.; Choca, M. (Hebrew Univ., Jerusalem). J. Inorg. Nucl. Chem.; 37: No. 6, 1429-1432 (Jun 1975).

The IR and Raman data for the uranium hexachlorides (UCl_6, UCl_6^- and UCl_6^{2-}) are reported. Vibrational frequencies are assigned on the basis of an O_h point group symmetry, and using the modified Urey-Bradely Force Field (MUBFF) and the Molecular Orbital Valence Force Field (MOVFF), a Normal Coordinate Treatment (NCT) was made. The trend of frequencies with oxidation state and counter ion, and the primary stretching force constant (K) variation with oxidation state and non-bonding valence electrons is discussed. (auth)

8595 INVESTIGATIONS ON CESIUM URANATES. I. Characterization of the Phases in the Cs–U–O System. Cordfunke, E. H. P.; van Egmond, A. B.; van Voorst, G. (Stichting Reactor Centrum Nederland, Petten). J. Inorg. Nucl. Chem.; 37: No. 6, 1433-1436(Jun 1975).

The Cs–U–O system was investigated by means of x-ray analysis, thermal analysis, and phase studies. Eight cesium uranate phases, in which uranium is hexavalent, were found. Their thermal stability in air was investigated and the formation of new phases is described. X-ray powder data of all phases are given. (auth)

8596 DIOXOURANIUM(VI) COMPLEXES WITH ALDOXIMES. Biradar, N. S.; Patil, M. D.; Goudar, T. R. (Karnatak Univ., Dharwar, India). J. Inorg. Nucl. Chem.; 37: No. 6, 1437-1439 (Jun 1975).

Dioxouranium(VI) complexes were prepared by treating uranyl nitrate with aldoxime in aqueous alcohol medium (pH = 8). The complexes are orange-yellow to yellow-brown in color. These complexes are characterized by elemental analysis, conductometric and spectral data. The intermolecular hydrogen bonding present in the ligands is still retained in the complexes. Based on these results an octahedral structure may be proposed. (auth)

8597 PHOTOREDUCTION OF THE URANYL ION WITH LASER LIGHT AND ETHANOL. II. The Effects of Temperature and Uranyl Concentration on the Uranyl-Ethanol Reaction. Bell, J. T.; Buxton, S. R. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 37: No. 6, 1469-1474(Jun 1975).

The effects of temperature and UO_2^{2+} concentration on the quantum yield for the photochemical reduction of UO_2^{2+} to U^{4+} with laser light and ethanol are described. As the temperature was increased, the quantum yield decreased through a minimum for the lower UO_2^{2+} concentrations (<0.1 M) but steadily increased for the higher UO_2^{2+} concentrations (≥0.5 M). The quantum yield at each temperature in the range 25 to 87°C was strongly dependent on UO_2^{2+} concentrations less than 0.2 M, and almost independent of UO_2^{2+} concentrations greater than 0.3 M. The essential considerations of the UO_2^{2+}–ethanol dark reaction and of various effects on the UO_2^{2+} absorbance at the specific argon laser wavelengths are also discussed. The UO_2^{2+}–ethanol reaction will occur in the dark, especially at the higher temperatures, and the activation energy for the reaction was determined to be 10.2 kcal. The equilibrium quotient at 25°C for the UO_2^{2+}–ethanol dark reaction was calculated to be $\sim 10^{-7}$. The effects of temperature and of UO_2^{2+} concentration on the UO_2^{2+} absorbance at the laser wavelengths are not equivalent to the same effects on the absorption at the peak wavelengths. It is suggested that the photochemical reduction of the U(V) intermediate plays a primary role in the mechanism for the photochemical reduction of UO_2^{2+} to U^{4+}. (auth)

8598 BEHAVIOR OF AMERICIUM(IV) IN PHOSPHORIC ACID SOLUTIONS. Myasoedov, B. F.; Milyukova, M. S.; Lebedev, I. A.; Litvina, M. N.; Frenkel, V. Ya. J. Inorg. Nucl. Chem.; 37: No. 6, 1475-1478(Jun 1975).

The completeness of Am(III) electrochemical oxidation in 3 to 15 M H_3PO_4 depending on phosphoric acid and americium concentration, as well as the influence of H_3PO_4, americium concentration and temperature on Am(IV) stability in phosphoric acid solutions has been investigated. It has been found that in 3 to 8 M H_3PO_4 an Am(IV) disproportionation occurs according to the scheme: 3Am(IV) → 2Am(III) + Am(VI), and in solutions with H_3PO_4 concentration greater than 10 M–an Am(IV) reduction to Am(III). The apparent rate constant of Am(IV) disporportionation increases with H_3PO_4 concentration decrease; the rate constant of Am(IV) reduction increases with the decrease of americium concentration, phosphoric acid concentration (15 to 10 M), and with the increase of temperature. The activation energy for the reaction Am(IV) → Am(III) in 12 M H_3PO_4 is 15.6 ± 1.1 kcal, $mole^{-1}$. The mechanism of Am(IV) and Am(VI) formation during electrochemical oxidation of Am(III) is discussed. (auth)

8599 SEPARATION OF TRITIATED METHANES. Leonov, V. V.; Sakodynskii, K. I.; Sinotova, E. N.; Korsakov, M. V. (Physical-Chemical Scientific Research Inst., Moscow). Russ. J. Phys. Chem.; 48: No. 9, 1385-1386(Sep 1974).

Translated from Zh. Fiz. Khim.; 48: No. 9, 2343-2344.

Retention times in the gas-chromatographic separation of tritiated methanes on PAU-1 active carbon at 0 to 50°C decrease on passing from methane to tetratritiomethane. (auth)

Radioactive Waste Treatment

Refer also to abstract 8903.

8600 (ANL-75-23) CHEMICAL ENGINEERING DIVISION WASTE MANAGEMENT PROGRAMS. Quarterly Report, October–December 1974. Steindler, M. J.; Levitz, N. M.; Mecham, W. J.; Seefeldt, W. B.; Trevorrow, L. E.; Winsch, I. O.; Cannon, T. F.; Gerding, T. J.; Kullen, B. J.; Webster, D. S.; Burris, L. (Argonne National Lab., Ill. (USA)). Mar 1975. Contract W-31-109-Eng-38. 39p. Dep. NTIS $4.00.

In the study of the consolidation of Zircaloy hulls, emphasis was continued on the potential for pyrophoric reactions and the separation of zirconium from contaminants. Reaction of Zircaloy and zinc chloride yields volatile zirconium tetrachloride under moderate conditions. Uranium and ceric oxides added to the metal appeared unaffected by contacting with $ZnCl_2$. An attempted separation of zirconium tetrachloride from zinc chlorides by simple sublimation was not successful. Preliminary studies on compaction of simulated Zircaloy hulls by drop hammer and by hydraulic press revealed no unusual or hazardous consequences. A review of experiences with similar operations on a commercial scale is provided. Recent progress in analyzing methods of disposing of tritium-bearing low-level aqueous waste is presented. Work on the reliability of high-level waste canisters included a review of methodology appropriate to the retrievable surface storage facility. Data on a major mode of failure such as stress corrosion cracking of stainless steel is reviewed in detail, with particular emphasis on the role of metallurgical characteristics and impurities in the water. Stresses developed by contraction of the canister and glass during cooling from the filling temper-

ature and stresses developed due to pressurization by water vapor and nitrate decomposition products are identified. (auth)

8601 (ARH-ST-118B) ATLANTIC RICHFIELD HANFORD COMPANY SEMIANNUAL REPORT, BB PROCESS DEVELOPMENT, MAY 1, 1974 THROUGH OCTOBER 31, 1974. Fox, R. D. (ed.). (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Jan 1975. Contract AT(45-1)-2130. 69p. Dep. NTIS $4.25.

In the area of Pu processing results are reported for PuO_2 dissolution in HNO_3-HF, leaching Pu from soil, Pu recovery from scrap with acid-leached ash, dilution of amberlite with trichlorobenzene in Pu reclamation, amine solvent extraction of Pu, bidentate organophosphorus extraction of Am and Pu, and disposal of waste organic solvent. In the area of waste management results are reported for the concentration of nonboiling wastes, reduction of hygroscopicity of salt cake, fabrication of wiped film evaporator for residual liquor, solidification by aqueous silicate process, characterization of waste tank salt cake, mobile vacuum systems for cleanup of surficial radioactive contamination, waste characterization, environmental monitoring instrumentation, and waste tank leak detection and prevention. (JSR)

8602 (BNL-20009) DEVELOPMENT OF DURABLE LONG-TERM RADIOACTIVE WASTE COMPOSITE MATERIALS. Progress Report No. 10, January–March 1975. Colombo, P. (Brookhaven National Lab., Upton, N. Y. (USA)). Apr 1975. 23p. Dep. NTIS $4.25.

Process design development for aqueous nitrate wastes has continued with an emphasis on mixing techniques. In-drum mixing by an end-over-end tumbling technique is currently viewed as the most viable option. The effect of the method of adsorbent addition on cesium retention in cement concrete has also been studied. Leach testing of prospective cement-concrete and polymer impregnated concrete formulations has demonstrated cesium and strontium leach rates of as low as $<1.8 \times 10^{-7}$ g/cm^2-day after 73 days. The kinetics of cesium and strontium adsorption by Linde AW-500 zeolite and $Fe(OH)_3$-MnO_2 respectively were investigated. Calcine produced from simulated AGNS ILLW waste was analyzed for cesium, strontium, nitrate, and potassium content in preparation for leach testing. The compressive stengths of calcium aluminate-diatomaceous earth cement concretes were measured in a continuing effort to optimize formulations for the disposal of BNL low level radioactive waste. (auth)

8603 (BNWL-SA-5362) SINTERING OF RADIOACTIVE WASTES INTO A GLASS MATRIX. Ross, W. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1975. 19p. (CONF-750542-4). Dep. NTIS (US Sales Only) $4.00.

From 77th annual meeting of the American Ceramic Society; Washington, District of Columbia, USA (3 May 1975).

From the work that has been done on sintering of radioactive wastes into a glass matrix the following conclusions were made: (1) waste calcines can be incorporated into a glass matrix at temperatures below 675°C; (2) the pellets are impervious and about 90 percent dense; (3) leach resistance of sintered pellets of spray calcines and frits are comparable to glass; (4) microstructures indicate that glass sintering is both reacting and encapsulating the waste in the glass matrix; and (5) storage temperatures should not exceed 700°C to avoid bloating and swelling. (LK)

8604 (BNWL-SA-5370) INCORPORATION OF HIGH LEVEL RADIOACTIVE WASTE IN GLASS: A REVIEW. Mendel, J. E.; McElroy, J. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. 25p. (CONF-750542-3). Dep. NTIS $4.25.

From 77th annual meeting of the American Ceramic Society; Washington, District of Columbia, USA (3 May 1975).

The incorporation into glass of high-level radioactive wastes resulting from the reprocessing of fuel from Light Water Power Reactors is reviewed. (LK)

8605 (BNWL-tr-145) DECONTAMINATION SECTION ANNUAL REPORT, 1972. Krause, H. (Kernforschungszentrum Karlsruhe (F. R. Germany)). 1972. Translation of KFK-2000. 148p. Dep. NTIS $10.50.

A number of bitumen-salt mixtures were prepared in order to investigate their resistance to irradiation and their thermal stability. Denitration by formic acid of fission product solutions could be extended into a conditioning procedure. It mainly consists in a partial redissolution of the precipitate formed after complete denitration. Studies on fixation of highly active fission products in glass and production of glass were reported. The thermite reaction of manganese dioxide and aluminum intended for production of a ceramic containing fission products was investigated in detail. A cleanser was developed for surface contamination, which in addition to good decontamination efficiency, shows little foam formation so that disturbances are reduced in waste water treatment. In studies on conventional waste water treatment experiments were carried out which related to the chemical regeneration of active charcoal, the purification through active charcoal of effluent water from cellulose plants, and the conditioning through irradiation of waste water. Preparations have begun at the borehole to be used for the disposal of tritiated waste waters. Work of the Project Group centered around the final storage of radioactive wastes in the Asse salt mine where the storage of medium-active wastes was started. Development of shielded transport containers was continued and also planning for the storage of highly active wastes and for the construction of a prototype cavern system. In all sectors covered by the Operation Group commissioning of the Karlsruhe Reprocessing Plant was strongly felt in 1972. Difficulties were encountered in the effluent water decontamination facility because of the installation of a new evaporator and damage to piping and pumps. Evaporator concentrates are now solidified into bitumen in a double-shaft extruder. The incineration facility which started operation last year has worked very satisfactorily. The number of decontaminations have also increased. The clarification plant operated almost without incident. (JSR)

8606 (DP-1382) EVALUATION OF GLASS AS A MATRIX FOR SOLIDIFICATION OF SAVANNAH RIVER PLANT WASTE. Nonradioactive and Tracer Studies. Kelley, J. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). May 1975. Contract AT(07-2)-1. 28p. Dep. NTIS $4.00.

One option for long-term management of Savannah River Plant high-activity waste is solidification and storage in a retrievable surface storage facility to be located on the plantsite. This study demonstrated that SRP waste can be incorporated into a borosilicate glass at 1150°C. Tests with simulated waste indicate that alkaline sludge stored in SRP waste tanks can be solidified in borosilicate glass containing up to 45 wt. percent sludge. For melting at 1150°C, the optimum glass mixture is 52.5 wt. percent SiO_2, 10.0 percent B_2O_3, 22.5 percent Na_2O, 5.0 percent CaO, and 10.0 percent TiO_2. Aluminum increases glass melt viscosity and can limit the amount of sludge solidified. Sulfate has limited solubility; above 0.8 to 1.0 wt. percent sulfate, a separate, water-soluble, cesium-rich phase is formed. During melting, approximately 0.5 percent of the cesium, 10 to 50 percent of the ruthenium, and all of the mercury present in the glass mixture are volatilized. At 25°C, initial leachabilities for both ^{137}Cs and ^{85}Sr are approximately 10^{-6} g/(cm^2-day) and both decrease to approximately 10^{-8} g/(cm^2-day) after 40 days. Gamma irradiation to 10^{10} rads and alpha decay in the glass matrix do not significantly affect the glass waste forms. Devitrification of waste glasses occurs near 600°C, but leachability is increased by only a factor of approximately 3. (auth)

8607 (KY-G-300) ANALYSIS OF A MULTICOMPONENT GAS ABSORPTION SYSTEM WITH CARRIER GAS COABSORPTION. Merriman, J. R. (Paducah Gaseous Diffusion Plant, Ky. (USA)). Mar 1975. Contract W-7405-eng-26. 119p. Dep. NTIS $9.00.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

Conventional integrated versions of the packed gas absorber design equations do not account for significant coabsorption of the carrier gas along with the dilute transferring species. These equations, as a result, also neglect the relationship between dilute component transfer and carrier gas coabsorption. In the absorption of Kr and Xe from various carrier gases, using CCl_2F_2 as the process solvent, carrier coabsorption is substantial. Consequently, a design package was developed to deal with multicomponent gas absorption in systems characterized by carrier gas coabsorption. Developed within the general film theory framework, the basic feature of this design approach is a view of dilute component mass-transfer as a conventional diffusive transfer superimposed on a net flux caused by carrier absorption. Other supporting elements of the design package include predictive techniques for various fluid properties, estimating procedures for carrier gas equilibrium constants, and correlations for carrier gas and dilute gas mass-transfer coefficients. When applied to systems using CCl_2F_2 as the solvent; He, N_2, air, or Ar as the carrier gas; and Kr or Xe as the dilute gas; the design approach gave good results, even when extended to conditions well beyond those of its development. (auth)

8608 STUDY OF THE SORPTION OF COBALT-60 BY THERMOACTIVATED MONTMORILLONITE CLAY. Tashpulatov, D.; Aripov, E. A.; Sultanov, A. S. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 12, 17-19(1974). (In Russian).

A total of 0.5 g of $Co(NO_3)_2 \cdot 6H_2O$ was irradiated in a reactor at a neutron flux of 2×10^{13}/cm^2-sec, and dissolved in solution to give 2×10^{-6} mg of cobalt per ml. Clays activated at temperatures of 100 to 800°C were contacted with this radioactive solution. Maximum adsorption of cobalt-60 was observed on montmorillonite

activated at 300 to 400°C. Cobalt-60 is almost completely removed from solution by 8 g/l of clay adsorbent (99.5% removal). Thus it is possible to use natural mineral sorbents in order to decontaminate slightly contaminated water from long-lived, radioactive cobalt-60. (SJR)

8609 ION EXCHANGE METHODS FOR THE TREATMENT OF LIQUID RADIOACTIVE WASTES. Lomoro, A.; Panciati, G. (Centro Applicazioni Militari Energia Nucleare, S. Piero a Grado, Italy). Inquinamento; 15: No. 8, 23-26(Oct 1973). (In Italian).

8610 ISOLATING HIGH-LEVEL RADIOACTIVE WASTE FROM THE ENVIRONMENT: ACHIEVEMENTS, PROBLEMS, AND UNCERTAINTIES. Report to the Congress by the Comptroller General of the United States. RED-75-309. Washington, DC; Comptroller General of the United States (1975). 49p. GAO $1.00.

The AEC's progress in insuring safe storage of high-level radioactive waste generated by AEC and industry is reviewed. Sources, quantities, hazards, and methods of handling various types of radioactive waste are considered. (LK)

Radioisotope Production

8611 KINETIC STUDY OF THE EXCHANGE PROCESS OF ^{111}Ag AND ^{198}Au ON A MERCURY-ELECTROLYTE SOLUTION INTERFACE. Madi, I.; Bolyos, A. (Kossuth Lajos Tudomanyegyetem, Debrecen, Hungary). Inorg. Nucl. Chem. Lett.; 11: No. 6, 429-434(Jun 1975).

The method of electrochemical displacement consists essentially in the deposition of the relatively nobler radioactive atom present in ionic state in the solution, on the surface of the less noble metal and this deposition can be regarded as an exchange process. Haissinsky [J. Chim. Phys., 45, 212(1948)] was the first to apply this method to the separation of artificially produced radioactive atoms. In the experiments reported in this paper a study was made of the kinetics of the spontaneous deposition of $^{111}Ag^{+}$ and $^{198}Au^{3+}$ on mercury surfaces. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 8907, 9023, and 9198.

8612 (GERHTR-141) CHLORINEX: DEVELOPMENT OF A METHOD FOR THE HIGH-TEMPERATURE CHLORINATION OF Th-CONTAINING FUEL ELEMENTS AS HEAD-END STAGE OF THE REPROCESSING. Bohnenstingl, J.; Gebhardt, H.; Laser, M.; Lossmann, G. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). Oct 1974. 56p. (In German). (JUL-1129-CT). Dep. NTIS (US Sales Only) $6.00.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

The grinding and chlorination of high-temperature fuel elements was developed as the head-end stage for reprocessing. The method has advantages with respect to the presently used combustion head-end where the emission of ^{14}C must be controlled. The research installation has a through-put of 1 kg metal/day. The spherical fuel elements were crushed in an installation consisting of a hammer mill and a disc crusher. A circulating air current removes the fine grains. Approximately 70 to 75% of the crushed product has a grain size between 0.4 and 0.05 mm. The rest is under 0.05 mm. The crushed product is continuously fed to a fixed-bed chlorination reactor and reacted with Cl_2 at 1000 to 1200°C. The chlorides of Th, U, and some fission products are volatilized. They are precipitated in snow-like form in the desublimator. The U yields are at 99% and above. Tracer studies with ^{95}Zr, ^{103}Ru, ^{134}Cs, and ^{140}La show an extensive volatilization of Zr, a partial volatilization of Cs and Ru, and a negligible volatilization of La. The Cl_2 used in excess can be recycled. $SiCl_4$ from the chlorination of SiC coatings can be separated by rectification of the volatile Cl_2. The research studies have been made only on a laboratory scale to date. (tr-auth)

8613 (REG/G-3,27(5-75)) NONDESTRUCTIVE EXAMINATION OF WELDS IN THE LINERS OF CONCRETE BARRIERS IN FUEL REPROCESSING PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). May 1975. 4p. NRC.

Procedures are described that are acceptable to the NRC staff for meeting requirements with regard to the nondestructive examination of welds in the metal liners and penetrations of confinement barriers of concrete construction. Methods, personnel, standards, records, etc., are discussed. An appendix gives the procedure and requirements for examination of welds by the vacuum box method. (MCG)

8614 (REG/G-3,28(5-75)) WELDER QUALIFICATION FOR WELDING IN AREAS OF LIMITED ACCESSIBILITY IN FUEL REPROCESSING PLANTS AND IN PLUTONIUM PROCESSING AND FUEL FABRICATION PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). May 1975. 2p. NRC.

A method acceptable to the NRC staff for meeting the requirements with regard to the control of welding of nuclear components for fuel reprocessing plants and for plutonium processing and fuel fabrication plants is described. Performance qualification is discussed. (MCG)

8615 PROCESS FOR RECOVERING URANIUM AND PLUTONIUM FROM IRRADIATED NUCLEAR FUEL OXIDES. Miller, W. E.; Lenc, J. F.; Winsch, I. O. (to U.S. Atomic Energy Commission). US Patent 3,867,510. C01g56/00. 18 Feb 1975. Filed date 23 Apr 1973. 19p.

PAT-APPL-353,255.

A process is described for recovering uranium and plutonium from liquid-metal-cooled nuclear reactor irradiated fuel assemblies as well as a process for preparing uranium nitride, plutonium nitride, and mixed uranium–plutonium nitride reactor fuels. The fuel oxides are separated from the fuel assemblies and reduced in a liquid-metal reduction solvent, thereby forming uranium and plutonium metal dissolved therein. This solvent is then contacted by a bed of particulate calcium nitride or magnesium nitride to react the dissolved uranium and plutonium with the particulate nitride to form insoluble particles of uranium nitride, plutonium nitride, and uranium–plutonium nitride mixtures. The bed of reacted particles is then removed from the solvent and retorted to remove any remaining liquid solvent and to volatilize any unconverted calcium nitride or magnesium nitride. This results in recovering the uranium and plutonium in the form of uranium nitride, plutonium nitride and uranium–plutonium nitride mixtures. (auth)

8616 THE REPROCESSING AND WASTE TREATMENT PROJECT OF THE GfK (PWA). Kroebel, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Wiederaufarbeitung und Abfallbehandlung). KFK-Nachr.; 6: No. 4, 4-8(1974). (In German).

Following a review on the international position of reprocessing of light water reactor fuel elements, research and development work to be carried out by the Gesellschaft fuer Kernforschung for the Federal Republic in the next few years is described. The research and development work is to enable, with international cooperation, the construction and operation of a fully available, economically feasible reprocessing plant by 1985 supported by private enterprise and thus to secure the nuclear supply of the fuel cycle for LWR. (GE)

8617 SOME BASIC CONSIDERATIONS CONCERNING THE EXTRACTION FLOW DIAGRAM OF A LARGE-SCALE REPROCESSING PLANT. Koch, G.; Ochsenfeld, W.; Schmieder, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Heisse Chemie). KFK-Nachr.; 6: No. 4, 17-22(1974). (In German).

A review is given on the technological state of experience in the field of reprocessing of spent nuclear fuels according to the Purex method. A few basic considerations are discussed on the extraction part of the flowsheet which lead to a series of starting points for the adaptation of the present solvent extraction technology to the requirements of on LWR processing plant of large throughput. (GE)

8618 ELECTROLYTIC METHODS IN THE PUREX PROCESS. Schmieder, H.; Goldacker, H.; Warnecke, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Heisse Chemie). KFK-Nachr.; 6: No. 4, 22-27(1974). (In German).

Electrolysis in the extraction apparatus itself has proved to be the most effective solution for the PU-U separation and the Pu back-extraction. The extraction apparatus has two functions: electrolytic reduction and extractive separation. Mixed-settlers may be used for this in which the settler chamber preferably serves as electrolytic chamber. This principle is also applicable in extraction columns with continuous aqueous phase by insertion of an 'electrolytic floor'. The Pu reoxidation steps can be carried out by anodic oxidation of the Pu(III) nitrate in electrolytic flow cells. A further possibility to apply an electrolytic method is obtained by the electrolytic destruction of an excess of nitric acid and nitric acid oxalate solutions. (GE)

CONTROLLED THERMONUCLEAR RESEARCH

8619 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Cumulative index. Volume 8, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 213p.

8620 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 9, No. 4, 1975. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 49p.

8621 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 9, No. 3, 1975. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 53p.

8622 PHYSICS OF TRANSITORY PROCESSES AND PLASMA AND GAS-DISCHARGE PHYSICS. Spring Conference of the German Society of Physics, Duesseldorf, Germany, March 4–7, 1975. Verhandlungen der Deutschen Physikalischen Gesellschaft, No. 7. Weinheim, Ger.; Physik Verlag GmbH (1975). 71p. (In German and English). (CONF-750315–(Absts.)).

From spring conference of the German Society of Physics; Duesseldorf, F. R. Germany (4 Mar 1975).

Abstracts are compiled of papers on physics of transitory processes and plasma and gas-discharge physics. Topics discussed in the physics of transitory processes are lasers, laser diagnostics, laser effects, collision waves and ultrasonic waves, x-ray flash techniques, and explosives and ballistics. Topics discussed in plasma and gas-discharge physics are electric arcs, plasma walls and lasers, plasma diagnostics, laser scattering, spectroscopy, wave resonances and plasma resonances, belt pinch, plasma focussing, and theta pinch. (JSR)

Plasma Confinement and Heating

Refer also to abstract 9984.

8623 (CEA-CONF-2910) A LHR HEATING SLOW WAVE LAUNCHING STRUCTURE SUITED FOR LARGE TOROIDAL EXPERIMENTS. Lallia, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1974. 8p. INIS.

From summer school symposium on plasma heating in toroidal devices; Varenna, Italy (3 Sep 1974).

In reactor oriented devices like Tokamaks or stellarators ($n_e > 5.10^{13}$ cm^{-3}, B = 30 – 40 KG on the axis), the low hybrid resonance frequency is approximately 800 MHz, allowing a waveguide attack. However, the "accessibility" condition requires slowing down the wave parallel to B, which is usually produced by some mechanical structure located between the plasma and the vacuum wall. In this paper, a new structure consisting of a compact set of properly phased waveguides, called "Grill", which is able to launch effectively a slow wave to the plasma without reducing the useful cross-section of the liner is described. Low hybrid resonance (LHR) heating is the rf heating at the highest frequency for which the power level needed for ignition experiments is credible in the near future. Already in some existing Tokamaks, and in some future larger devices, the LHR heating could fully exploit the advantages of waveguide launching. (FR)

8624 (CEA-CONF-2911) WEGA ASTELLARATOR FOR RF HEATING STUDIES. Ichtchenko, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1974. 13p. INIS.

From summer school symposium on plasma heating in toroidal devices; Varenna, Italy (3 Sep 1974).

WEGA a joint experiment of IPP Garching, CEA Grenoble and ERM Bruxelles, is now under construction in Grenoble. It is designed as an ohmically heated stellarator whose parameters and performances should be intermediate between WENDELSTEIN II and WENDELSTEIN VII, and comparable with CLEO or with a tokomak like PETULA. The lower hybrid resonance heating will be investigated during the first experimental phase in view of the application to the next generation experiments (w VII or JET). The present paper intends to summarize the principle, parameters, and experimental program of WEGA. (FR)

8625 (COO-3632-27) NONLINEAR CONTROL OF TURBULENCE AND VELOCITY SPACE DIFFUSION IN BEAM PLASMA SYSTEMS. Final Report. Walsh, J. E. (Dartmouth Coll., Hanover, N. H. (USA)). 6 Jun 1975. 20p. Dep. NTIS $4.00.

Results of low energy electron beam-plasma heating experiments are discussed. A figure of merit which can be used to compare different beam heating experiments is presented. Some general observations about the possibility of useful beam plasma heating are mentioned. (auth)

8626 (EUR-CEA-FC-756) STUDY OF THE HEATING OF A CONFINED PLASMA USING THE PARAMETRIC INSTABILITY OF A HIGH FREQUENCY ELECTROMAGNETIC WAVE. Iordachescu, V. V. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Dec 1974. 92p. (In French). INIS.

The parametric interaction of electrostatic waves in a plasma with an electromagnetic pumping wave, of frequency close to the electron plasma frequency ω(pe), is investigated. The decompositions photon→plasmon plus phonon and photon→plasmon plus plasmon are studied in turn. An oblique angle of incidence for the pump wave, in extraordinary mode, a finite value k_0 for the number of pump waves and a static magnetic field B_0 are assumed. A dispersion equation is obtained from Vlasov's equation and is then analysed for the two types of decomposition concerned. The importance of a treatment which accounts for the pump wave value k_0 is shown, especially for the second decomposition studied. From the non-linear susceptibility calculation, which takes into account the first-order modulation effects of the pump (E,B) in the presence of a static magnetic field, the incident radiation intensity threshold and the instability growth rate close to and well above this level can be determined the instability saturation process understood a necessary condition for the study of the non-linear instability variation. For the photon→plasmon plus plasmon decomposition the values found for the electric field strength at the instability threshold are lower (the plasma being assumed homogeneous) than those corresponding to the photon→plasmon plus phonon decomposition, the values of the other parameters remaining constant. As the value of the ratio k_0/k decreases the threshold of this instability rises quickly (for the same theta$_1$, theta$_2$, ω_1, ω_2 values. (FR)

8627 (LA-5957-MS) LASER-PLASMA INTERACTIONS IN THE SCYLLA I-C EXPERIMENT: PRELIMINARY ANALYSIS. York, T. M.; McKenna, K. F. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1975. Contract W-7405-eng-36. 22p. Dep. NTIS $4.00.

The interaction of high power laser beams with plasmas has recently received considerable theoretical and experimental attention. However, experimental determination of the laser-plasma interaction mechanisms in theta-pinch plasmas is limited. This work considers the interaction of a 3 x 10^{10}W/cm^2 peak flux CO_2 laser beam with the magnetically confined plasma generated in the Scylla I-C theta-pinch. For the specific constraints of the CO_2 laser and Scylla I-C, and with the theta-pinch fill pressure as a primary variable (100 mT–1000 mT), the physical problems of plasma heating, laser light backscatter, and channeling (converging diffraction of the laser beam) are considered. Prediction of the theta-pinch plasma parameters, prior to laser heating, is developed using snowplow theory. (auth)

8628 (MATT-1003) HEATING MECHANISM, ELECTRON THERMAL CONDUCTIVITY AND PARTICLE DIFFUSION COEFFICIENT IN HIGH ELECTRON TEMPERATURE PLASMA PRODUCED BY HIGH POWER MICROWAVE HEATING IN THE FM-1 SPHERATOR. Okabayashi, M. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Sep 1973. Contract AT(11-1)-3073. 15p. (CONF-730705-29). Dep. NTIS $4.00.

From sixth European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973).

The high power microwave heating in internal ring Toroidal device FM-1 spherator is investigated from three different aspects. (1) heating mechanism, (2) electron thermal conductivity, and (3) particle diffusion coefficient. The heating mechanism is attributable to parametric heating. The observed electron thermal conductivity is slightly higher than the particle diffusion coefficient. (auth)

8629 (MATT-1129) FAST AND SLOW ION CYCLOTRON WAVE GENERATION AND HEATING IN THE ST TOKAMAK. Hosea, J. C. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). May 1975. Contract AT(11-1)-3073. 28p. (CONF-740969-4). Dep. NTIS $4.50.

From symposium on plasma heating in toroidal devices; Varenna, Italy (3 Sep 1974).

An experimental program designed to determine the feasibility

of employing the abundant rf energy presently available to further heat the ions of the tokamak plasma was performed on the ST Tokamak. Two essential features were explored: 1) wave generation and 2) ion heating. Wave generation has proven to be classical in that the waves expected from theory were excited and their predicted loading of the launching structure was observed. Ion heating by the fast wave was significant (typically ion temperatures were increased by a factor of two with an efficiency of approximately 20 percent) but is hindered in the ST Tokamak by ion tail losses presumably through the ion orbit loss cones. Slow wave heating is less efficient and is presumably hindered by the peculiarities of the slow wave propagation in a torus. Projections for this heating scheme to larger devices are optimistic for the fast wave. The loss cones virtually disappear and higher radial modes may be excited to more uniformly deposit the wave energy. (auth)

8630 (SAND-75-0214) RELATIVISTIC ELECTRON BEAM HEATING OF A TOKAMAK PLASMA. Swain, D. W.; Miller, P. A.; Widner, M. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1975. Contract AT(29-1)-789. 43p. Dep. NTIS $5.25.

For the United States Energy Research and Development Administration.

A theoretical treatment of heating of tokamak plasmas by relativistic electron beam (REB) injection is presented. Comparisons with prior work and considerations for both research and reactor sized systems are included. Guiding center orbits for beam electrons in a tokamak are obtained and requirements for significant beam penetration of the plasma are determined. Interaction mechanisms of the beam with the plasma are reviewed and ion heating and runaway problems are considered. Results indicate that, under a reasonable set of assumptions: (1) The REB can be injected to penetrate into the plasma volume and will be trapped in the plasma; (2) The beam should heat the plasma electrons due to beam-plasma instability or return current heating, and some direct ion heating may occur; (3) The classical rate of energy transfer from electrons to ions would be great enough in a system satisfying the Lawson condition to convert much of the REB energy to ion energy, in case direct ion heating did not occur. (auth)

8631 DIAMAGNETIC LOOPS IN BEAM-PLASMA HEATING EXPERIMENTS. Striffler, C.D.; Kapetanakos, C.A. (Plasma Physics Division, Naval Research Laboratory, Washington, D.C. 20375). J. Appl. Phys. 46: No. 6, 2509-2515 (June 1975).

The effect of an electron beam on the output signal of a diamagnetic loop, used in beam-plasma heating experiments, is studied by examining the diffusion of a magnetic field pulse through a cylindrically symmetric plasma column. The source of the magnetic field pulse in the calculations is a thin rotating E layer which has a trapezoidal shape in time. Exact analytical expressions are obtained for the electric and magnetic fields and for the integrated output of a diamagnetic loop placed outside the plasma column. It is shown that only for low plasma conductivity does the diamagnetic signal at all resemble the shape of the beam current pulse. The results are not sensitive to the shape of the beam current pulse. (auth)

8632 ENDLOSS FROM A LINEAR THETA-PINCH. Freidberg, J. P. (Los Alamos Scientific Lab., NM); Weitzner, H. Nucl. Fusion; 15: No. 2, 217-223(Apr 1975).

An analytic model is presented for calculating the endloss from a linear θ-pinch. The model includes all the important physics features of previously derived theories (i.e. a throat condition and an area wave) as well as extends the results to include diffuse profiles. The results are compared with experiment. Despite the relative level of sophistication in the model, the conclusion is that the theory gives qualitative, but not quantitative agreement with experiment. The present theory does give better agreement than the previous theories, but nonetheless there are still significant differences with regard to experiment. (auth)

8633 RADIATION PENETRATION IN PLASMA ON THE ASSUMPTION OF STOCHASTICALLY VARYING LASER FREQUENCY. Anderson, D.; Wilhelmsson, H. (Chalmers Univ. of Tech., Goteborg). Nucl. Fusion; 15: No. 2, 201-205(Apr 1975).

The influence of a stochastically varying laser frequency or finite laser bandwidth upon nonlinear reflection processes occurring for laser radiation incident on a plasma is considered. It is shown that the penetration efficiency can be greatly enhanced by introducing a certain amount of noisiness into laser radiation. (auth)

8634 MEASUREMENT OF PLASMA FLOW VELOCITY INTO THE DIVERTOR OF THE FM-1 SPHERATOR BY USING ION ACOUSTIC WAVE PROPAGATION. Hsuan, H.; Okabayashi, M.; Ejima, S. (Princeton Univ., NJ). Nucl. Fusion; 15: No. 2, 191-194(Apr 1975).

The plasma flow velocity into the divertor chamber of the FM-1 Spherator is determined by measuring the propagation velocity of ion acoustic waves. The observed parametric dependence of plasma flow into the divertor is consistent with the plasma sheath model, which is now frequently used for designing poloidal divertor devices. (auth)

8635 PLASMA ION HEATING BY ADIABATIC DIAMAGNETIZATION. Millar, D. D. (Univ. of Sydney). Plasma Phys.; 17: No. 4, 305-308(Apr 1975).

Attention is drawn to the fact that if a collisionless plasma in a static magnetic field is subjected to the sudden switch-on of an electric field perpendicular to the magnetic field, with a rise-time short compared with the ion cyclotron period, or alternatively, if the process of ionization occurs in crossed static E and B fields, then the internal energy of the ion component will comprise not only the kinetic energy of drift but also an equal kinetic energy of gyrational motion in the drifting frame of reference. For near-collisionless ions this process will give rise to ion heating. For deuterium ions nuclear fusion collisions may be expected for sufficiently high E/B values. (auth)

8636 INTERACTION BETWEEN A MODULATED INTENSE RELATIVISTIC ELECTRON BEAM AND A BACKGROUND PLASMA. Mondelli, A. A.; Auer, P. L. (Maxwell Labs., Inc., San Diego, CA). Plasma Phys.; 17: No. 3, 213-223(Mar 1975).

A density-modulated intense relativistic electron beam can resonantly interact with a mode of a background plasma to effect a rapid transfer of energy from the beam to the plasma. The modulated beam has been modeled with a finite train of N charged discs in uniform translation along the direction of an externally applied magnetic field. This structure is allowed to interact with a cold, uniform plasma in a magnetic field. The beam-driven fields in the plasma are computed, with particular attention given to the "synchronous" modes ($\omega/k_{||} = V_0$). In the limit where $k_\perp \gg k_{||}$, the lower hybrid mode of the plasma is a synchronous mode of the system. The rate of resonant energy transfer from the beam to this mode has been computed in the high-density limit ($\omega_{pe}^2 \gg \Omega_e^2$). For typical parameters the characteristic time required for transfer is found to be short compared with the beam pulse duration. (auth)

8637 TWO-DIMENSIONAL SIMULATION OF FLUID INSTABILITY IN LASER-FUSION PELLETS. Lindl, J.D.; Mead, W.C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. Lett. 34: No. 20, 1273-1276 (19 May 1975).

Two-dimensional numerical-simulation techniques have been used to study fluid instability in laser-fusion pellets. Comparisons with analytic solutions in nonablating test cases show good agreement. Isentropic ablative accelerations exhibit growth rates 50%–100% of Rayleigh-Taylor values, while nonisentropic cases show suppressed growth. Design optimization has led to an impulsively accelerated, low-aspect-ratio shell which operates successfully with a surface perturbation of a few tens of angstroms. (auth)

8638 HIGH-FREQUENCY DRIVEN ION-CYCLOTRON INSTABILITY. Edgley, P.D.; Franklin, R.N.; Hamberger, S.M.; Motley, R.W. (EURATOM-United Kingdom Atomic Energy Authority Association for Fusion Research, Culham Laboratory, Abingdon, Oxfordshire, United Kingdom). Phys. Rev. Lett. 34: No. 20, 1269-1272 (19 May 1975).

The mechanism of the high-frequency driven ion-cyclotron instability is investigated and shown, for a Q-machine plasma column with symmetric external excitation, to correspond to a three-wave resonant process in which an electron-plasma wave decays into an electrostatic ion-cyclotron wave and an oppositely propagating electron-plasma wave, all waves being in their lowest-order mode. (auth)

8639 TWO-DIMENSIONAL CALCULATION OF ELECTRON-BEAM-TARGET INTERACTION. Zinamon, Z.; Nardi, E.; Peleg, E. (The Weizmann Institute of Science, Rehovot, Israel). Phys. Rev. Lett. 34: No. 20, 1262-1266 (19 May 1975).

The interaction of a pinched relativistic electron beam with a solid target is calculated by use of the Monte Carlo method for energy deposition and two-dimensional particle-in-cell (PIC) hydrodynamics to take into account the full effect of target expansion. Bremsstrahlung emission is also evaluated through the use of the Monte Carlo method. Self-magnetic-field effects are neglected. It is found that target expansion can considerably reduce the efficiency of energy deposition in the focal region. (auth)

8640 TURBULENT PLASMA HEATING AND THE BUNEMAN INSTABILITY. Sizonenko, V.L. (Physicotechincal Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 19: No. 9, 1260-1261 (Mar 1975).

The nonlinear stage of the kinetic Buneman instability is analyzed. The scattering of resonant electrons by fluctuations of the electric field leads to an anomalously rapid increase in the electron thermal velocity to the velocity characteristic of the current. (auth)

8641 PLASMA ELECTRON HEATING BY INJECTION OF LOW-ENERGY ELECTRONS. Hershkowitz, N.; Leung, K.N.

(Department of Physics, University of California, Los Angeles, California 90024). Appl. Phys. Lett. 26: No. 11, 607-609 (1 June 1975).

It is shown that the electron temperature of a multidipole plasma can be significantly increased by injecting electrons with energy less than the ionization potential of the neutral gas. Electron temperatures determined from Langmuir probes and ion-acoustic waves show close agreement. (auth)

8642 NEUTRAL INJECTION HEATING EXPERIMENTS ON THE OAK RIDGE TOKAMAK DEVICE. Berry, L.A.; Callen, J.D.; Colchin, R.J.; Kelley, G.G.; Lyon, J.F.; Rome, J.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. Lett. 34: No. 17, 1085-1088 (28 Apr 1975).

Proton heating varying from 10 to 40% as plasma density is decreased has been observed as a result of energetic H^0 beam injection parallel to the discharge current on the ORMAK device. The change in ion temperature agrees with a theoretical heating calculation in both density scaling and magnitude. In contrast to the results reported for the ATC device at Princeton Plasma Physics Laboratory, no measurable heating was observed for an antiparallel beam. (auth)

8643 PLASMA HEATING BY A ROTATING RELATIVISTIC ELECTRON BEAM. Kapetanakos, C.A.; Black, W.M. (Naval Research Laboratory, Washington, D. C. 20375); Chu, K.R. Phys. Rev. Lett. 34: No. 18, 1156-1159 (5 May 1975).

A rotating relativistic beam of energy 500 keV and current 20–40 kA is injected into a preformed plasma of density n_p between 10^{12} and 10^{14} cm^{-3}. It is observed that optimum coupling of beam energy to the plasma occurs at $n_p > n_b$, where n_b is the beam density. The peak plasma temperature is about 1 keV. The heated plasma undergoes radial oscillations characteristic of the magnetosonic mode. The results are interpreted with a new theoretical model. (auth)

8644 CERTAIN SINGULARITIES OF THE ABSORPTION OF HIGH-POWER LASER RADIATION HEATING A LiD TARGET. Gorokhov, A.A.; Dyatlov, V.D.; Ivanov, V.B.; Medvedev, R.N.; Starikov, A.D. (State Optical Institute). JETP Lett. 21: No. 1, 28-30 (5 Jan 1975).

We observed a dependence of the reflection coefficient on the energy of the preceding background when crystalline targets of LiD were exposed to radiation from a neodymium laser with intensity $10^{15} \leq I \leq 3 \times 10^{16}$ W/cm^2. The connection between the reflection coefficient and the intensity of the incident radiation is determined. (auth)

8645 FLUCTUATIONS AND PLASMA LOSS IN THE $l = 3$ JIPP STELLARATOR. Dodo, T.; Fujiwara, M.; Ogata, A.; Miyamoto, K. (Nagoya Univ., Japan). Nucl. Fusion; 15: No. 2, 295-299(Apr 1975).

Fluctuations and anomalous particle loss of a xenon afterglow plasma, which appear immediately after the decay of convective cells in an $l = 3$ stellarator, are investigated experimentally. This instability is caused by a static electric field directed into plasma. The fluctuation propagates in the direction of the $\vec{E}_0 \times \vec{B}_0$ rotation, which is parallel to the electron diamagnetic current, and is expressed as $\exp[i(m\theta + n\phi - \omega t)]$, $m = 2$ and $n = -1$, where θ is measured in the poloidal and ϕ in the toroidal direction. A dispersion relation is derived from a model in which there is a difference of rotation velocity between ions and electrons, and the electron-ion collision in the electron motion parallel to the magnetic field is included. The difference in rotation velocities comes from the effect of finite ion Larmor radius and the centrifugal force. The dispersion relation derived here also includes the resistive drift instability. The growth rate takes maximum values on the rational magnetic surfaces. Predictions on the basis of the dispersion relations are in good agreement with observed wave propagation, frequency, growth rate, and plasma loss. (auth)

8646 ENERGY BALANCE IN A LOW-Z BAR HIGH-DENSITY HELIUM PLASMA IN THE ST TOKAMAK. Bretz, N.; Dimock, D. L.; Hinnov, E.; Meservey, E. B. (Princeton Univ., NJ). Nucl. Fusion; 15: No. 2, 313-317(Apr 1975).

Helium discharges have been produced in the ST Tokamak with electron densities exceeding 10^{13} cm^{-3}, with less than 1% oxygen (and other light impurities) and less than 0.05% metallic impurities. In such discharges, the effect of the impurities on the plasma resistivity is relatively unimportant, and, consequently the usual ambiguities about the radial current distribution are unusually small. We find, consistently with previous experiments and in spite of various quantitative differences, that the plasma resistance is determined by Spitzer resistivity, that the rise of electron temperature is limited by the development of the $q = 1$ surface and that the electron kinetic energy confinement time is equal to the average particle confinement time. Energy loss by electrons constitutes about three quarters of the total and is roughly divided between line radiation and kinetic energy transport. (auth)

8647 USE OF ENERGETIC HELIUM ATOMS FOR HEATING TOROIDAL SYSTEMS. Thompson, E. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 15: No. 2, 347-349(Apr 1975).

Some of the advantages and disadvantages of using ions other than the plasma ion species are examined, in particular helium, for heating by high-energy neutral injection. The choice of primary ions and their influence on the design and development of neutral injectors is discussed. The choice of atom species used for plasma heating is essentially governed by three factors: (a) the penetration of the fast atoms into the plasma; (b) the efficiency of production of the fast atoms, and (c) the impurity introduced by the beam if we use non-plasma ions (density increase if we use plasma ions). These three criteria are examined for next generation experiments with particular reference to He^0. (MOW)

Plasma Diagnostics

Refer also to abstracts 8631 and 8733.

8648 (IPP–2/227) COMPUTING THE ELECTRON DENSITY PROFILE FROM MICROWAVE INTERFEROMETER MEASUREMENTS. Baker, K. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Nov 1974. 81p. Dep. NTIS (US Sales Only) $7.25.

The plasma electron density profile can be deduced by measuring the phase change ϕ over the plasma length using a multichannel microwave interferometer. An APL program originally developed by J. G. Wegrove to calculate this density and which is used on WIIB was changed to provide a faster calculation time as well as modified to allow one to simulate the plasma numerically. The program was also enlarged to investigate various beam properties. The stellarator geometry prohibits the use of parallel probing beams which can be used with tokamaks. Moreover, the plasma cross section is closer to an ellipse than a circle which further complicates evaluation techniques. With the APL program, profiles can be produced quickly while experimental measurements are being taken. However, a FORTRAN translation primarily for use in Grenoble with Wega was made as the programs were further developed to include an error evaluation and an iteration technique in searching for an optimum beam spacing. Calculations using the geometrical configuration foreseen for Wega indicate that the mathematical technique used to deduce the density profile from a numerically simulated plasma yielded reasonable profiles even when 20% experimental error on phase measurements was included. There was found to be no unique optimum beam configuration. Dealing with each individual beam, it was found exact focusing is not critical. Assuming a fan-shaped microwave beam instead of an infinitely thin one introduced an error of approximately 10%. The programs and their use is described in detail. All are related to the FORTRAN program PROFILE in which one inputs experimental values of phase change 4 or 4 values deduced from an assumed density. It gives as output an approximation of the density profile. (auth)

8649 (JUL–1175) MEASUREMENT OF ELECTRON DENSITIES IN PLASMA–CHEMICAL AND RADIATION–CHEMICAL EXPERIMENTS. Roeth, E. P.; Schindler, R. N. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Physikalische Chemie). Dec 1974. 25p. Dep. NTIS (US Sales Only) $4.25.

Three methods are described for the determination of electron densities and changes thereof in a weakly ionized gas. Electron densities in the wide range of 10^2 to 10^{13} per cm^3 can be measured with these techniques. Density changes can be followed with a time resolution down to the nanosecond range. Applications of the methods are indicated in the fields of plasma chemistry and radiation chemistry. (auth)

8650 (SAND-75-5014) DYE LASER SPECTROMETER FOR THE ANALYSIS OF PULSED VACUUM ARCS. Hargis, P. J. Jr.; Robertson, M. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 8p. (CONF-750520-2). Dep. NTIS $4.00.

From IEEE Optical Society of American conference on laser engineering and applications; Washington, District of Columbia, USA (28 May 1975).

A pulsed dye laser spectrometer which is used to obtain detailed single shot spectroscopic measurements of the plasma in a pulsed vacuum arc was developed. The capabilities of this spectrometer are indicated by the detection of laser induced fluorescence signals from 10^6 neutral Ti atoms in the plasma of a pulsed vacuum arc with a Ti anode. (auth)

8651 POSSIBILITY OF DETERMINING THE CHARACTERISTICS OF LASER PLASMA BY MEASURING THE NEUTRONS OF THE DT REACTION. Gamalii, E.G.; Gus'kov, S.Yu.; Krokhin, O.M.; Rozanov, V.B. (P.N. Lebedev Physics Institute, USSR Academy of Sciences). JETP Lett. 21: No. 2, 70-72 (20 Jan 1975).

The characteristics of a laser plasma in a target of $(CD_2)_n$ can be determined by measuring the neutrons of the DT reaction. The ratio of

the number of DT and DD neutrons produced in the plasma, and the spectrum of the DT neutrons, make it possible to determine the plasma temperature and density. (auth)

8652 MEASUREMENT OF THE INTENSITY OF THE 2–10 Å RADIATION EMITTED BY LASER PLASMAS GENERATED FROM TARGETS WITH NUCLEAR CHARGES Z=12–23 AND DETERMINATION OF THE PLASMA ELECTRON TEMPERATURE. Boiko, V.A.; Krokhin, O.N.; Pikuz, S.A.; Faenov, A.Ya. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 10, 1212-1215 (Apr 1975).

Measurements were made of the temperature of laser plasmas formed by irradiation (with a flux of $\sim 5\times10^{14}$ W/cm^2 density) of targets containing deuterium and heavy-element impurities and of homogeneous targets with the nuclear charge in the range Z=12–23. The temperature was deduced from the relative intensities of dielectronic satellites and resonance lines of heliumlike/and hydrogenlike ions. The dimensions of various regions of a laser plasma jet, characterized by temperatures in the range 200–800 eV, were estimated. The absolute intensities of the spectral lines in the 2–10 Å range indicated that the plasma radiation power ranged from 10^4 to 10^8 W. (auth)

8653 FIELDS OF SHORT RADIO-FREQUENCY PROBES IN A MAGNETIZED PLASMA. Singh, N. (Department of Electrical Engineering, Indian Institute of Technology, Kanpur 208016 U.P., India). J. Appl. Phys. 46: No. 6, 2491-2495 (June 1975).

The diagnostics of a magnetized plasma can be done by measuring the spacings of the interference structure in the angular distribution of the field of a properly excited probe in the plasma. In this paper the effect of probe dimensions on the interference structure is investigated. The sheath around the probe is found to have profound effects on the angular distribution of both the phase and the amplitude of the field of the probe. This investigation reveals that only thin electric dipole of half-length less than 30 Debye lengths or so is useful for the plasma diagnostics. (auth)

8654 NONLINEAR RESPONSE OF A PLASMA TO SUPERPOSED ELECTRIC FIELDS. Willett, J.E. (Department of Physics, University of Missouri-Columbia, Columbia, Missouri 65201). J. Appl. Phys. 46: No. 6, 2483-2485 (June 1975).

An analysis is presented which describes the nonlinear response of the electrons in a weakly ionized plasma to superposed time-dependent electric fields. Two or more uniform fields with frequencies $\omega + n\Omega$, where $\omega > \Omega$ and the n are small positive and/or negative integers, are considered. A method of calculating the current density is developed which is based upon solution of the Boltzmann equation by use of a single Fourier series in a quasiperiodic approximation. Measurement of the amplitude and phase shift of the nonlinear current density at frequency ω is proposed as a diagnostic technique. (auth)

8655 HIGH-ENERGY IONS FROM A CO_2 LASER-PRODUCED PLASMA. Ehler, A.W. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). J. Appl. Phys. 46: No. 6, 2464-2467 (June 1975).

A time-of-flight ion collector was used to measure the energy of ions from the plasma produced by a high-power CO_2 laser pulse focused on a flat polyethylene target. At laser irradiances exceeding 5×10^{12} W/cm^2 at the target, high-energy ion current spikes appeared in addition to the ion current from an expanding thermalized plasma. The measured arrival time of these spikes was consistent with the assumption that ions of different charge and mass were accelerated by a high potential during the laser pulse which was produced by a steep pressure gradient at the plasma surface. The accelerating potential (equal to the measured energy of a singly charged ion) was proportional to the laser irradiance at the target to the 2/3 power. At an irradiance of 2×10^{14} W/cm^2, the H^+ ion energy was 140 keV. About 90% of the total ion energy appeared as high-energy ions. (auth)

8656 ANALYSIS OF LIGHT SCATTERING DATA FROM RELATIVISTIC PLASMAS. Mattioli, M.; Papular, R. (CEN, Fontenay-aux-Roses, France). Plasma Phys.; 17: No. 3, 165-172(Mar 1975).

The relativistic theory developed by previous authors for the spectral profile of a Thomson scattered wave is applied to the highest temperatures expected from currently planned fusion machines (25 keV). Adequate procedures for data reduction and error analysis are described and applied to experimental results collected on TFR. These computations yield corrected temperatures and error bars which differ already considerably from those obtained by the usual procedures. The temperatures are as much as 35 per cent lower, and the errors 50 per cent less, than the corresponding classical values. (auth)

8657 APPLICABILITY OF X—RAY FILTER METHOD TO THERMOMETRY OF A NONCORONA $(CH_2)_n$ LASER-PRODUCED PLASMA. Rager, J.P.; Robouch, B.V. (Laboratori Gas Ionizzati (Associazione CNEN/Euratom), Frascati, Rome, Italy). Appl. Phys. Lett. 26: No. 12, 664-665 (15 June 1975).

It is shown that the temperature as deduced by the filter method is unaffected by departures from the corona ionization equilibrium for a low-temperature carbohydride laser-produced plasma. (auth)

8658 MEASUREMENT OF PLASMA DENSITY DISTRIBUTION WITH A RECTANGULAR MICROWAVE CAVITY. Moskalev, I.N. Sov. Phys.—Tech. Phys. 19: No. 9, 1168-1170 (Mar 1975).

The feasibility of using multimode microwave cavities with a rectangular cross section to measure an arbitrary plasma density distribution $n(r, \varphi)$ is investigated. It is shown that the loss of information associated with the odd harmonics of the Fourier expansion of the function $n(r, \varphi)$ makes it impossible to measure an arbitrary distribution. (auth)

8659 HOLOGRAPHIC MICROINTERFEROMETRY OF LASER-PRODUCED PLASMAS WITH FREQUENCY-TRIPLED PROBE PULSES. Attwood, D.T.; Coleman, L.W.; Sweeney, D.W. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). Appl. Phys. Lett. 26: No. 11, 616-618 (1 June 1975).

Holographic microinterferometry is used to study plasmas produced by high-intensity subnanosecond pulses from a Nd laser. The probing pulse is frequency tripled to 3547 Å in order to reduce refractive errors due to steep density gradients and to reduce spatial resolution requirements. Measured electron densities as high as one-fourth critical for 1.06 μm are presented. Factors concerning the extension of these measurements to 10^{21} electrons/cm^3 are discussed. (auth)

8660 THERMAL X-RAY SPECTRA AND IMPURITIES IN THE ST TOKAMAK. Von Geoler, S.; Stodiek, W.; Eubank, H.; Fishman, H.; Grebenshchikov, S.; Hinnov, E. (Princeton Univ., NJ). Nucl. Fusion; 15: No. 2, 301-311(Apr 1975).

A study is made of the spectral distribution of the soft x-ray emission produced by the thermal part of the electron velocity distribution in the ST Tokamak. The slopes of the spectra are in good agreement with the prediction from laser measurement of electron temperature if radial profile effects are taken into account. The absolute intensity is a factor 5 to 100 larger than is expected for hydrogen bremsstrahlung. This enhancement can be quantitatively accounted for by recombination radiation from oxygen and heavy-metal impurities. The enhancement factor ζ was measured at different radii, in order to study the impurity distribution in the tokamak. These, as well as other experiments, in which high-Z gases (Xe, Kr, A) were pulsed into the discharge, indicated that, within the measuring accuracy, Z_{eff} does not vary substantially with radius. (auth)

Plasma Kinetics (General)

8661 PLASMA METHODS OF ACCELERATION. Fainberg, Y. B. (Physical-Technical Inst., Kharkov). Part. Accel.; 6: No. 2, 95-106(1975).

Theoretical and experimental investigations on methods of acceleration in plasma are presented; these investigations are based on the use of waves excited by electron beams in plasma waveguides. The following problems are treated: the increase in excitation effectiveness by intense relativistic beams of plasma waves essential to acceleration; the interaction of relativistic modulated beams with plasma, and others. The experiments made so far are shown to be in full agreement with theory. (auth)

8662 CONVERGING-BARREL PLASMA ACCELERATOR. Paine, T. O. US Patent 3,579,028. H01j1/50; H01j7/24; H05b1/00. 18 May 1971. Filed date 23 Oct 1968. 4p.

PAT-APPL-769,998.

The invention comprises a device for generating and accelerating plasma to extremely high velocity, while focusing the plasma to a decreasing cross section for attaining a very dense high-velocity plasma burst capable of causing nuclear fusion reactions. A converging coaxial accelerator-electrode configuration is employed with "high-pressure" gas injection in controlled amounts to achieve acceleration by deflagration and focusing by the shaped electromagnetic fields. (auth)

8663 ION ENERGY SPECTRA AND COLLECTIVE EFFECTS IN A PENNING ION SOURCE. Farenik, V.I.; Vlasov, V.V.; Rozhkov, A.M.; Kozharin, A.A. (A. M. Gor'kii Khar'kov State University). Sov. Phys.—Tech. Phys. 19: No. 9, 1258-1259 (Mar 1975).

It has been shown experimentally that the energy spectrum of an ion beam extracted along the magnetic field from a Penning source is governed by any instability which occurs in the source plasma. In the case of the ion-cyclotron instability the spectral half-width is much larger than in the case of low-frequency ($\omega_{LF} < \omega_{HI}$) drift waves. The regimes corresponding to ion-cyclotron and drift instabilities are determined. (auth)

Plasma Kinetics (Experimental)

8664 (UCRL-76831) MEASUREMENT OF THE DISTRIBUTION OF VERY ENERGETIC IONS IN THE PLASMA FOCUS DEVICE. Gullickson, R. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 May 1975. 24p. (CONF-750531-3). Dep. NTIS $4.00.

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It is shown that the multiple water-bag model, with both analytical and numerical properties, is fairly well suited to the study of forced oscillations launched by grid systems, for different geometries with possible nonuniform charge distribution, and for any distance within the range 0–100 Debye lengths. (auth)

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The magnetohydrodynamic equations are solved using an explicit numerical scheme for the focus geometry together with the electrical circuit equation. The influence of varying circuit parameters, focus apparatus dimensions, and filling pressure on the discharge characteristics, especially the maximum current, and the plasma variables in the pinch phase are examined and compared with experimentally determined neutron outputs. An experimentally derived scaling law for the dependence of maximum neutron output on bank energy, filling pressure, and length of the inner electrode is confirmed by the results of the MHD computations. (auth)

8672 KINETIC EQUATIONS FOR PLASMAS SUBJECTED TO A STRONG TIME-DEPENDENT EXTERNAL FIELD. III. Stochastic Equations for Plasma Turbulence. Balescu, R.; Misguich, J. H. (Univ., Brussels). J. Plasma Phys.; 13: No. 1, 33-51(Feb 1975).

The kinetic equation obtained in parts 1 and 2 (Balescu, R. & Misguich, J. H., 1974, J. Plasma Phys., 11, 357; 1974, J. Plasma Phys., 11, 377) is treated stochastically: the external field is stochastic, with an average and a fluctuating part. The turbulence of the system is described by the induced fluctuations in the plasma, and a general equation is derived for the average distribution function. As a particular case, the stochastic Vlasov equation is treated explicitly, and compared with the descriptions of Dupree (Dupree, T. H., 1966, Phys. Fluids, 9, 1773), Weinstock (Weinstock, J., 1969, Phys. Fluids, 12, 1045) and Benford & Thomson (Benford, G. & Thomson, J. J., 1972, Phys. Fluids, 15, 1496). (auth)

8673 ROLE OF ENERGY AND MOMENTUM CONSERVATION IN NONLINEAR BEAM–PLASMA INTERACTION. Jungwirth, K. (Ceskoslovenska Akademie Ved, Prague). J. Plasma Phys.; 13: No. 1, 1-26(Feb 1975).

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It is found that, for a fully-ionized, homogeneous plasma in a high-frequency electric field, the fundamental term $\bar{g}_1$ in the kinetic-energy correction is defined by the intensity and frequency of the electric field and by the collision frequency ν_1. The Debye-Hükel energy correction in $\bar{g}_2$, too is obtained, as it was by Theimer & Wright (Theimer, O. & Wright, T., 1969, Phys. Rev. 180, 308), but this term is much smaller than g_1, and its coefficient is no longer a constant. (auth)

8675 STOCHASTIC ACCELERATION OF ELECTRONS IN NANOSECOND DISCHARGES. Babich, L.P. Sov. Phys.–Tech. Phys. 19: No. 9, 1154-1156 (Mar 1975).

Stochastic acceleration is possible for some electrons in field-emission beams in the cathode plasma of nanosecond discharges in air at atmospheric pressure. Equations are derived which relate the energy of the stochastically accelerated electrons to the density and energy of the beam, the density and temperature of the plasma electrons, and the beam dimensions. (auth)

8676 EXACT GROUND-STATE WAVE FUNCTION FOR A ONE-DIMENSIONAL PLASMA. Sutherland, B. (The Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. Lett. 34: No. 17, 1083-1085 (28 Apr 1975).

I have determined with exact ground-state wave function and ground-state energy for a one-dimensional plasma, with density-dependent short-range force. In particular, I am able to approach the thermodynamic limit of finite density, and verify that the ground-state energy is extensive, provided that there is a uniform density of neutralizing charge. (auth)

8677 KINETIC EQUATIONS FOR PLASMAS SUBJECTED TO A STRONG TIME-DEPENDENT EXTERNAL FIELD. IV. Dynamics of Stochastic Correlations. Balescu, R.; Misguich, J. H. (Univ , Brussels). J. Plasma Phys.; 13: No. 1, 53-61 (Feb 1975).

In close analogy with part 1 (Balescu, R. & Misguich, J. H., 1974, J. Plasma Phys., 11, 357), the dynamics of stochastic correlations is used to reformulate the preceding treatment of turbulent equations. The result is an exact and closed equation for an average function, involving only asymptotic stochastic correlations, and no initial fluctuation. This stochastic kinetic equation is valid for all initial conditions, and the corresponding function is a significant particular projection on an independent subspace R(t). (auth)

8678 EQUILIBRIUM IN AN OCTOPOLE TOKAMAK WITHOUT CONDUCTING SHELL. Sakurai, K.; Tanaka, Y.; Okuda, T. (Nagoya Univ., Japan). Plasma Phys.; 17: No. 4, 261-269(Apr 1975).

A numerical method for solving free boundary problems in an axially symmetric toroidal configuration is described. Approximate solutions for equilibrium plasmas are given for a fixed external magnetic field. The equilibrium plasma in the multipole configuration consisting of a uniform vertical magnetic field and a shaping field is discussed. A shift of the equilibrium position leads to a change of the cross-section shape from rectangular to a D- or to a tear-drop type. The plasma equilibria with the D-shaped cross section are horizontally unstable and an off-centre equilibrium is obtained. It is also shown that the safety factor and the well depth are increased by adding the shaping magnetic field. (auth)

8679 MAXWELL FIELD, ITS ADJOINT FIELD, AND THE CONJUGATE FIELD IN ANISOTROPIC ABSORBING MEDIA. Suchy, K. (Univ., Duesseldorf); Altman, C. J. Plasma Phys.; 13: 299-316(Apr 1975).

In absorbing media, where Maxwell's equations are not self-adjoint, the adjoint field is introduced via the differential operator adjoint to the Maxwell operator. The concomitant vector can be made equal to the time averaged Poynting vector at a boundary with a non-absorbing medium. In general, the adjoint field represents an electromagnetic field in a medium other than the absorbing medium under consideration. To draw conclusions about the latter, a "conjugate field" in this medium is defined, using a conjugating transformation of the Maxwell operator and field. Relations between the conjugate and adjoint fields are established, allowing one to gather physical information about the first absorbing medium from the adjoint field. (auth)

8680 SIMPLE PHYSICAL MODEL FOR THE EFFECT OF A MAGNETIC FIELD ON THE COULOMB LOGARITHM FOR TEST IONS SLOWING DOWN ON ELECTRONS IN A PLASMA. McNally, J. R. Jr. (Oak Ridge National Lab., TN). Nucl. Fusion; 15: No. 2, 344-346(Apr 1975).

A simple physical model for the test-ion case is presented. Some examples of the effect for the advanced fuels DD and ^{6}LiD are given. (MOW)

Plasma Production

Refer also to abstract 8655.

8681 (LA-UR-75-660) LASER FUSION: AN OVERVIEW. Boyer, K. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 19p. (CONF-750460-1). Dep. NTIS $4.25.

From third conference on the laser; New York, New York, USA (22 Apr 1975).

The laser fusion concept is described along with developments in neodymium and carbon dioxide lasers. Fuel design and fabrication are reviewed. Some spin-offs of the laser fusion program are discussed. (MOW)

8682 (SAND-75-5027) TWO DIMENSIONAL HYDRODYNAMIC RESPONSE OF REB TARGETS AND SUBSEQUENT WITNESS PLATE DAMAGE. Widner, M. M.; Chang, J.; Yonas, G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 2[illegible] (CONF-750531-2). Dep. NTIS $4.25.

From IEEE international conference on plasma science; Ann Arbor, Michigan, USA (14 May 1975).

Two-dimensional hydrodynamic calculations are described for imploding hemispherical and spherical targets and the subsequent anode damage. Various symmetric and asymmetric loadings are considered with corresponding variations in anode damage. Also predictions for flash radiographs are made from computed hydrodynamic solutions. (MOW)

8683 (SAND-75-5029) IRRADIATION OF A SPHERICAL TARGET BY A SINGLE RELATIVISTIC ELECTRON BEAM. Chang, J.; Widner, M. M.; Kuswa, G. W.; Yonas, G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 11p. (CONF-750531-5). Dep. NTIS $4.00.

From IEEE international conference on plasma science; Ann Arbor, Michigan, USA (14 May 1975).

An experimental study of single Relativistic Electron Beam (REB) irradiation of spherical targets was conducted to determine deposition symmetry. A 700 keV, 300 kA, 100 nsec beam was used with diagnostics consisting of x-ray pinhole photography, flash radiography, and evaluation of anode backing plate damage. The degree of symmetry was typically much better than 2 : 1 over the target surface, indicating that single beam irradiation could be an acceptable approach to pellet fusion. (auth)

8684 (UCRL-51788) MEASUREMENT OF LASER FUSION CAPSULES USING THE INTERFEROMETER METHOD OF EXCESS FRACTIONS. Stone, R. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Apr 1975. Contract W-7405-Eng-48. 17p. Dep. NTIS $4.00.

A system is proposed to allow use of the method of excess fractions with a high-power interference microscope. This allows the measurement of average wall thicknesses for small (less than 200-mu m o.d., and from 0.5- to 2.0-mu m wall thicknesses) transparent laser fusion targets to better than 0.5 percent and wall uniformity to better than 0.3 percent. The DT gas fill of the capsules can be nondestructively measured to about +-3 percent. (auth)

8685 PURELY IONIC SYNTHESIZED PLASMA. Baribaud, M.; Dolique, J.M.; Monte, J.; Zadworny, F. (Laboratoire de Physique des Plasmas, Equipe de Recherche Associée au CNRS, Université de Grenoble I, Grenoble, France). Rev. Sci. Instrum. 46: No. 6, 768-772 (June 1975).

A synthesized plasma containing no electrons but only positive H^+ and negative H^- ions has been made from a very intense H^- ion source. A rectilinear H^- ion beam, extracted from a Penning-type source through a magnetic shield, crosses a gaseous target. By two-electron collisional detachment, positive ions are created which, according to the gas pressure and target depth, can balance the negative current intensity of the negative remaining ions. Precautions have been taken to avoid any pollution by electrons. Such purely ionic plasma beams have a density in the range 10^{12}–10^{13} m^{-3}, with a velocity of the order of 10^6 m/sec. This particular kind of plasma was first obtained in 1970 and reported in 1971. (auth)

8686 IRRADIATION OF A SPHERICAL TARGET BY A SINGLE RELATIVISTIC ELECTRON BEAM. Chang, J.; Widner, M.M.; Kuswa, G.W.; Yonas, G. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. Lett. 34: No. 20, 1266-1269 (19 May 1975).

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8687 ENERGY DEPOSITION BY FAST NEUTRONS IN LASER COMPRESSED D−T PELLETS. Beynon, T. D. (Univ. of Birmingham, Eng.); Constantine, G. J. Phys., G. (London); 1: No. 3, L23-L27(1 Apr 1975).

Results of calculations are given for the moderation of 14-MeV neutrons produced by the fusion reaction in a compressed D-T sphere, radius 6×10^{-4} cm, density 2×10^{-3}. It is shown that, in addition to the 3.5 MeV energy available to the pellet from the α particle, 0.9 MeV is deposited by the neutrons. (auth)

Plasma Stability

Refer also to abstracts 8638 and 8640.

8688 EQUILIBRIUM AND LOCALIZED FLUTE INSTABILITY OF A TOKAMAK WITH NONCIRCULAR CROSS SECTION. Okamoto, M. (Japan Atomic Energy Research Inst., Tokai, Japan); Wakatani, M.; Amano, T. Nucl. Fusion; 15: No. 2, 225-236 (Apr 1975).

Plasma Kinetics (Experimental)

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8676 EXACT GROUND-STATE WAVE FUNCTION FOR A ONE-DIMENSIONAL PLASMA. Sutherland, B. (The Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. Lett. 34: No. 17, 1083-1085 (28 Apr 1975).

I have determined with exact ground-state wave function and ground-state energy for a one-dimensional plasma, with density-dependent short-range force. In particular, I am able to approach the thermodynamic limit of finite density, and verify that the ground-state energy is extensive, provided that there is a uniform density of neutralizing charge. (auth)

8677 KINETIC EQUATIONS FOR PLASMAS SUBJECTED TO A STRONG TIME-DEPENDENT EXTERNAL FIELD. IV. Dynamics of Stochastic Correlations. Balescu, R.; Misguich, J. H. (Univ , Brussels). J. Plasma Phys.; 13: No. 1, 53-61 (Feb 1975).

In close analogy with part 1 (Balescu, R. & Misguich, J. H., 1974, J. Plasma Phys., 11, 357), the dynamics of stochastic correlations is used to reformulate the preceding treatment of turbulent equations. The result is an exact and closed equation for an average function, involving only asymptotic stochastic correlations, and no initial fluctuation. This stochastic kinetic equation is valid for all initial conditions, and the corresponding function is a significant particular projection on an independent subspace R(t). (auth)

8678 EQUILIBRIUM IN AN OCTOPOLE TOKAMAK WITHOUT CONDUCTING SHELL. Sakurai, K.; Tanaka, Y.; Okuda, T. (Nagoya Univ., Japan). Plasma Phys.; 17: No. 4, 261-269(Apr 1975).

A numerical method for solving free boundary problems in an axially symmetric toroidal configuration is described. Approximate solutions for equilibrium plasmas are given for a fixed external magnetic field. The equilibrium plasma in the multipole configuration consisting of a uniform vertical magnetic field and a shaping field is discussed. A shift of the equilibrium position leads to a change of the cross-section shape from rectangular to a D- or to a tear-drop type. The plasma equilibria with the D-shaped cross section are horizontally unstable and an off-centre equilibrium is obtained. It is also shown that the safety factor and the well depth are increased by adding the shaping magnetic field. (auth)

8679 MAXWELL FIELD, ITS ADJOINT FIELD, AND THE CONJUGATE FIELD IN ANISOTROPIC ABSORBING MEDIA. Suchy, K. (Univ., Duesseldorf); Altman, C. J. Plasma Phys.; 13: 299-316 (Apr 1975).

In absorbing media, where Maxwell's equations are not self-adjoint, the adjoint field is introduced via the differential operator adjoint to the Maxwell operator. The concomitant vector can be made equal to the time averaged Poynting vector at a boundary with a non-absorbing medium. In general, the adjoint field represents an electromagnetic field in a medium other than the absorbing medium under consideration. To draw conclusions about the latter, a "conjugate field" in this medium is defined, using a conjugating transformation of the Maxwell operator and field. Relations between the conjugate and adjoint fields are established, allowing one to gather physical information about the first absorbing medium from the adjoint field. (auth)

8680 SIMPLE PHYSICAL MODEL FOR THE EFFECT OF A MAGNETIC FIELD ON THE COULOMB LOGARITHM FOR TEST IONS SLOWING DOWN ON ELECTRONS IN A PLASMA. McNally, J. R. Jr. (Oak Ridge National Lab., TN). Nucl. Fusion; 15: No. 2, 344-346(Apr 1975).

A simple physical model for the test-ion case is presented. Some examples of the effect for the advanced fuels DD and ^{6}LiD are given. (MOW)

Plasma Production

Refer also to abstract 8655.

8681 (LA-UR-75-660) LASER FUSION: AN OVERVIEW. Boyer, K. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 19p. (CONF-750460-1). Dep. NTIS $4.25.

From third conference on the laser; New York, New York, USA (22 Apr 1975).

The laser fusion concept is described along with developments in neodymium and carbon dioxide lasers. Fuel design and fabrication are reviewed. Some spin-offs of the laser fusion program are discussed. (MOW)

8682 (SAND-75-5027) TWO DIMENSIONAL HYDRODYNAMIC RESPONSE OF REB TARGETS AND SUBSEQUENT WITNESS PLATE DAMAGE. Widner, M. M.; Chang, J.; Yonas, G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 25p. (CONF-750531-2). Dep. NTIS $4.25.

From IEEE international conference on plasma science; Ann Arbor, Michigan, USA (14 May 1975).

Two-dimensional hydrodynamic calculations are described for imploding hemispherical and spherical targets and the subsequent anode damage. Various symmetric and asymmetric loadings are considered with corresponding variations in anode damage. Also predictions for flash radiographs are made from computed hydrodynamic solutions. (MOW)

8683 (SAND-75-5029) IRRADIATION OF A SPHERICAL TARGET BY A SINGLE RELATIVISTIC ELECTRON BEAM. Chang, J.; Widner, M. M.; Kuswa, G. W.; Yonas, G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 11p. (CONF-750531-5). Dep. NTIS $4.00.

From IEEE international conference on plasma science; Ann Arbor, Michigan, USA (14 May 1975).

An experimental study of single Relativistic Electron Beam (REB) irradiation of spherical targets was conducted to determine deposition symmetry. A 700 keV, 300 kA, 100 nsec beam was used with diagnostics consisting of x-ray pinhole photography, flash radiography, and evaluation of anode backing plate damage. The degree of symmetry was typically much better than 2 : 1 over the target surface, indicating that single beam irradiation could be an acceptable approach to pellet fusion. (auth)

8684 (UCRL-51788) MEASUREMENT OF LASER FUSION CAPSULES USING THE INTERFEROMETER METHOD OF EXCESS FRACTIONS. Stone, R. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Apr 1975. Contract W-7405-Eng-48. 17p. Dep. NTIS $4.00.

A system is proposed to allow use of the method of excess fractions with a high-power interference microscope. This allows the measurement of average wall thicknesses for small (less than 200-mu m o.d., and from 0.5- to 2.0-mu m wall thicknesses) transparent laser fusion targets to better than 0.5 percent and wall uniformity to better than 0.3 percent. The DT gas fill of the capsules can be nondestructively measured to about +-3 percent. (auth)

8685 PURELY IONIC SYNTHESIZED PLASMA. Baribaud, M.; Dolique, J.M.; Monte, J.; Zadworny, F. (Laboratoire de Physique des Plasmas, Equipe de Recherche Associée au CNRS, Université de Grenoble I, Grenoble, France). Rev. Sci. Instrum. 46: No. 6, 768-772 (June 1975).

A synthesized plasma containing no electrons but only positive H^+ and negative H^- ions has been made from a very intense H^- ion source. A rectilinear H^- ion beam, extracted from a Penning-type source through a magnetic shield, crosses a gaseous target. By two-electron collisional detachment, positive ions are created which, according to the gas pressure and target depth, can balance the negative current intensity of the negative remaining ions. Precautions have been taken to avoid any pollution by electrons. Such purely ionic plasma beams have a density in the range 10^{12}–10^{13} m^{-3}, with a velocity of the order of 10^6 m/sec. This particular kind of plasma was first obtained in 1970 and reported in 1971. (auth)

8686 IRRADIATION OF A SPHERICAL TARGET BY A SINGLE RELATIVISTIC ELECTRON BEAM. Chang, J.; Widner, M.M.; Kuswa, G.W.; Yonas, G. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. Lett. 34: No. 20, 1266-1269 (19 May 1975).

An experimental study of irradiation of spherical targets by single relativistic electron beams has been conducted to determine deposition symmetry. A 700–keV, 300–kA, 100-nsec beam was used with diagnostics consisting of x-ray pinhole photography, flash radiography, and evaluation of anode-backing-plate damage. The degree of symmetry was typically much better than 2:1 over the target surface, indicating that single-beam irradiation could be an acceptable approach to pellet fusion. (auth)

8687 ENERGY DEPOSITION BY FAST NEUTRONS IN LASER COMPRESSED D–T PELLETS. Beynon, T. D. (Univ. of Birmingham, Eng.); Constantine, G. J. Phys., G. (London); 1: No. 3, L23-L27(1 Apr 1975).

Results of calculations are given for the moderation of 14-MeV neutrons produced by the fusion reaction in a compressed D-T sphere, radius 6×10^{-4} cm, density 2×10^{-3}. It is shown that, in addition to the 3.5 MeV energy available to the pellet from the α particle, 0.9 MeV is deposited by the neutrons. (auth)

Plasma Stability

Refer also to abstracts 8638 and 8640.

8688 EQUILIBRIUM AND LOCALIZED FLUTE INSTABILITY OF A TOKAMAK WITH NONCIRCULAR CROSS SECTION. Okamoto, M. (Japan Atomic Energy Research Inst., Tokai, Japan); Wakatani, M.; Amano, T. Nucl. Fusion; 15: No. 2, 225-236 (Apr 1975).

The equilibrium equations are solved for tokamaks with noncircular cross-sections, by the method of the expansion in powers of the inverse aspect ratio. The analysis is extended to a more general class of equilibria, especially to study the effect of nonuniformity of plasma current distribution. For tokamaks with noncircular cross-sections, a simplified condition of stability against localized flute disturbances is obtained, which is a direct extension of Shafranov and Yurchenko's result. The kinds of variation of the cross-sections of the magnetic surfaces which improve the stability criterion are considered. (auth)

8689 RELATIONSHIP BETWEEN MODULATIONAL INSTABILITY AND OSCILLATING TWO-STREAM INSTABILITY. Lashmore-Davies, C. N. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 15: No. 2, 213-216(Apr 1975).

The stability of a finite-amplitude monochromatic Langmuir wave is considered in one dimension. A dispersion relation is obtained which includes the decay, purely growing and modulational instabilities. It is shown that for an infinite-wavelength Langmuir pump wave the modulational and oscillating two-stream instabilities are the same. It is also pointed out that the threshold for the modulational instability is equal to the threshold for the inverse oscillating two-stream instability, in which the Langmuir wave energy is converted into electromagnetic radiation. (auth)

8690 ABSOLUTE MAXIMUM GROWTH RATES AND ENHANCEMENT OF UNSTABLE ELECTROMAGNETIC ION-CYCLOTRON WAVES IN MIXED WARM-COLD PLASMAS. Cuperman, S.; Gomberoff, L.; Sternlieb, A. (Tel Aviv Univ., Israel). J. Plasma Phys.; 13: 259-272(Apr 1975).

Analytic and numerical calculations of the absolute maximum growth rates and enhancement of the electromagnetic ion-cyclotron instability in mixed warm-cold plasmas are presented. For a plasma system consisting of warm and anisotropic protons ($\beta_p \equiv 8\pi n_{p,w} KT_{||,p}/B_0^2 \neq 0$, $A_p \equiv T_{\perp,p}/T_{||,p} - 1 \neq 0$) and cold protons, the following hold: (i) The growth rate of any mode $x \equiv \omega_r/\Omega_p$ is maximized for a relative cold plasma concentration $n_{p,c}/n_{p,w} = [(1-x)^3/1.5\beta_p x^2] - 1$. (ii) The absolute maximum growth rate occurs for an optimum $n_{p,c}/n_{p,w}$ value about $[\frac{16}{3}\beta_p(A_p+2)] - 1$. (iii) A significant enhancement occurs only if $P_p \equiv \beta_p A_p^2(A_p+1) < 1$. The enhancement decreases exponentially with increasing P_p values. (iv) But, in all cases with $n_{p,c}/n_{p,w} \neq 0$, the instability range in k space is increased by a factor of about $(1 + n_{p,c}/n_{p,w})^{\frac{1}{2}}$. Also presented are simple analytical (approximate) expressions for maximum growth rates and enhancement, as well as for the optimum relative cold plasma concentrations. (auth)

8691 LINEAR CROSS-FIELD INSTABILITY PROBLEM. Dysthe, B.; Misra, K. D.; Trulsen, J. K. (Tromsoe Univ., Norway). J. Plasma Phys.; 13: 249-257(Apr 1975).

A re-examination of the linear E × B instability problem for infinite stratified media gives results differing from those published. The main point is to warn against the application to inhomogeneous media of the usual instability criterion, as developed for homogeneous media. The fact that the dispersion relation gives complex values of ω for real k does not always indicate the existence of an instability. It could also describe propagation of a constant wave energy through an inhomogeneous medium. It is demonstrated that in certain situations it is possible to choose dependent variables in such a way that these two effects disentangle, allowing for a definite solution of the instability problem. (auth)

8692 THERMALIZATION OF A BEAM BY BEAM-PLASMA INTERACTION. Wakeren, J. H. A. V.; Hopman, H. J. (Stichting voor Fundamental Onderzoek der Materie, Amsterdam). J. Plasma Phys.; 13: 349-360(Apr 1975).

Measurements proving the successive excitation of two distinct instabilities by electron beam-plasma interaction along a plasma column are presented. The first, appearing near the gun, grows in space, until the beam is trapped in the wave electric field, and decays. In this process the time-averaged distribution function changes, from a δ-type distribution function, into a plateau. This new beam-plasma distribution is also unstable; and another instability grows until the beam is again trapped. Numerical calculations show that the second instability can be explained, assuming that the beam distribution thermalizes when propagating from the first instability to the second. (auth)

8693 COUPLED MODE APPROACH TO NON-LINEAR WAVE INTERACTIONS AND PARAMETRIC INSTABILITIES. Lashmore-Davies, C. N. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 17: No. 4, 281-303(Apr 1975).

The nonlinear interaction of a few coherent, weakly damped longitudinal and transverse waves in an unmagnetized plasma is considered by means of the coupled mode theory. Using the equations describing the nonlinear wave interactions the threshold electric fields and initial growth rates of a number of parametric instabilities are calculated. The following four instabilities, all of which are relevant to laser fusion are considered: (i) the parametric ion-acoustic-Langmuir wave interaction, (ii) the two plasmon decay, (iii) stimulated Raman scattering and (iv) stimulated Brillouin scattering. All these instabilities are driven by a large amplitude electro-magnetic wave (the pump). The first example is essentially two dimensional when the spatial dependence of the pump is included and therefore has a range of possible wave vector configurations. Two particular configurations are analyzed for one of which there is no purely growing instability when the pump is a travelling wave. (auth)

8694 FEEDBACK STABILIZATION OF REACTIVE INSTABILITIES. Richards, R. K.; Emmert, G. A.; Grubb, D. P. (Univ. of Wisconsin, Madison). Plasma Phys.; 17: No. 4, 271-280(Apr 1975).

The general theory of linear feedback stabilization of reactive instabilities is extended to include the effects of dissipation in the plasma and frequency-dependence in the sensor suppressor elements and in the external feedback circuit. The theory is in agreement with experiments performed using the flute instability in a magnetic mirror as a model. One noteworthy result is that frequency-dependence in the overall gain and phase shift of the feedback loop can cause destabilization at large gain. (auth)

8695 CLOSED INNER REGION SOLUTION INCLUDING VISCOSITY FOR RESISTIVE TEARING IN CYCLINDRICAL GEOMETRY. Hosking, R. J. (Waikato Univ., Hamilton, New Zealand). J. Plasma Phys.; 13: No. 1, 27-32(Feb 1975).

A closed solution for the increment in the logarithmic derivative $\Delta(Q)$ over the inner ('resistivity') region for resistive tearing theory in cylindrical geometry including "parallel" viscosity is compared with an earlier numerical solution. The singular point Q_{crit} about which $\Delta(Q)$ exhibits branch-point behavior in the presence of compressibility is identified; modification of the viscous theory, to include (for example) finite Larmor radius effects, is suggested. In the incompressible limit, a familiar (inviscid) stability criterion is recovered, in the presence of "parallel" viscosity. (auth)

8696 PLASMA INSTABILITY DUE TO AN ANISOTROPIC ELECTRON DISTRIBUTION. Lominadze, D.G.; Sizonenko, V.L. Sov. Phys.—Tech. Phys. 19: No. 9, 1150-1153 (Mar 1975).

The stability of a uniform plasma with a nonmonotonic electron velocity distribution in a plane perpendicular to the magnetic field is studied with a transverse current. It is shown that ion plasma instabilities due to a loss cone in the electron distribution in the presence of a transverse current occur even when the loss cone is almost filled. In turn, the appearance of the loss cone leads to an increase in the growth rate for electron cyclotron oscillations; these are unstable because of the transverse current. (auth)

8697 HIGH-FREQUENCY INSTABILITIES IN AN INHOMOGENEOUS, ANISOTROPIC FINITE-β PLASMA. Egorenkov, V.D.; Pyatak, A.I. Sov. Phys.—Tech. Phys. 19: No. 9, 1160-1162 (Mar 1975).

The electromagnetic instabilities in an inhomogeneous hot-electron ($T_e \gg T_i$) finite-β plasma with an anisotropic velocity distribution function are investigated. At frequencies $\omega_{Bi} < \omega < \omega_{Be}$ and wave lengths $v_{Te}/\omega_{Be} \ll \lambda_\perp \ll v_{Ti}/\omega_{Bi}$ firehose and mirror instabilities can develop in an anisotropic inhomogeneous plasma. In particular, the instabilities are related to the ion-acoustic mode and the whistler mode of a homogeneous plasma. The inhomogeneity in the plasma density and the external magnetic field has a strong effect on modes whose wavelength in the direction of the magnetic field $\lambda_{||}$ is large compared to the inhomogeneity scale length for the equilibrium plasma parameters. (auth)

8698 MAGNETOHYDRODYNAMIC STABILITY OF A NEUTRAL CURRENT LAYER IN A PLASMA. Bulanov, S.V. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.—Tech. Phys. 19: No. 9, 1246-1247 (Mar 1975).

The stability of a bounded plane layer of a current-carrying plasma has been investigated. The low-conductivity limit is considered, taking account of the compressibility of the medium and the thermal conductivity. The layer is found to be unstable in the long-wave limit. The characteristic decay rate is of the order of the isothermal acoustic velocity. (auth)

8699 TRANSVERSE-CURRENT PLASMA INSTABILITY. Lominadze, D.G.; Sizonenko, V.L. Sov. Phys.—Tech. Phys. 19: No. 9, 1145-1149 (Mar 1975).

The stability of a low-β plasma with a current perpendicular to the magnetic field is analyzed. Ion-acoustic waves that propagate across the magnetic field have a high excitation threshold and are not excited if the magnetic field is large when the directed velocity u is lower than the electron thermal velocity v_{Te}. Electron cyclotron waves for $u \sim v_{Te}$ and the Buneman instability $u \gg v_{Te}$ are analyzed. (auth)

8700 STABILITY OF THE CRITICAL SURFACE IN IRRADIATED PLASMA. Valeo, E.J.; Estabrook, K.G. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. Lett. 34: No. 16, 1008-1011 (21 Apr 1975).

The linear and nonlinear evolution of an instability of one-dimensional filaments in plasma is investigated. The relevance of these results to two-dimensional breakup of the critical surface in laser-plasma interactions is pointed out. (auth)

8701 STABILITY OF LOCALIZED PLASMA MODEL IN TWO AND THREE DIMENSIONS. Wilcox, J.Z.; Wilcox, T.J. (TRW Systems, Redondo Beach, California 90278). Phys. Rev. Lett. 34: No. 18, 1160-1163 (5 May 1975).

Stability against catastrophic radial collapse is demonstrated for initially well-behaved, localized solutions in a class of two- and three-dimensional wave equations characterized by saturating nonlinearities, which model various electrostatic and electromagnetic "caviton" structures in an asymptotically uniform plasma. This result contrasts sharply with mathematical predictions of equations with low-order nonlinearities. Discrete classes of possible quasistationary modes exhibit features comparable to atomic wave functions and differ qualitatively from one-dimensional structures. (auth)

8702 FINITE-BANDWIDTH EFFECTS ON THE PARAMETRIC INSTABILITY IN AN INHOMOGENEOUS PLASMA. Thomson, J. J. (Univ. of California, Livermore). Nucl. Fusion; 15: No. 2, 237-247(Apr 1975).

The effect of a finite-bandwith pump on the parametric instability is considered. First, the temporal problem with unequal damping rates is considered, with bandwidth modelled by a Kubo-Anderson process. Exact results are obtained for both the amplitudes and power in each decay mode, with an interesting asymmetry found. Next, the spatial problem with unequal group velocities is investigated for the cases of 1) finite homogeneous interaction region, and 2) linear density profile. Thresholds and growth rates are found including both the inhomogeneity and bandwidth effects. When values typical of laser fusion parameters are inserted, it is found that bandwidth may be an important method of stabilizing Raman and Brillouin scattering. (auth)

8703 STABILIZATION OF INHOMOGENEOUS MAGNETIZED PLASMA BY ($\Phi-\Phi$) FEEDBACK CONTROL. Kammash, T.; Uckan, N. A. (Univ. of Michigan, Ann Arbor). Nucl. Fusion; 15: No. 2, 287-293(Apr 1975).

Most investigations of feedback control of magnetically confined plasma have used the approach in which the control variable is the perturbed plasma density. In this paper, the use of another basic type of feedback control, namely the ($\varphi-\varphi$) type, in which the control variable is the local potential perturbation is examined. The basic equations for the study of electrostatic oscillations in inhomogeneous magnetized plasma are deduced and the results are applied to some known mirror instabilities. It is found that for present-day amplification systems the threshold densities set by microinstabilities can be increased by factors of the order of 100 or more and that, in some cases, geometric stabilization can also be acheived by feedback control. (auth)

8704 STABILITY BOUNDARIES OF TOKAMAKS WITH RESPECT TO RIGID DISPLACEMENTS. Rebhan, E. (Max-Planck-Institut fuer Plasmaphysik, Garching). Nucl. Fusion; 15: No. 2, 277-285(Apr 1975).

The stability of axially symmetric equilibria with respect to rigid displacements is studied by means of the energy principle. For horizontal displacements and flipping, the vacuum term is neglected, thus affording sufficient stability criteria. For vertical displacements the vacuum term is kept, thus yielding a necessary and sufficient condition. The resulting stability criteria are applied to simple algebraic equilibria and numerical results are presented. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 8767, 9997, and 10562.

8705 (BNWL-B-409) NEUTRON AND ALPHA PARTICLE ENERGY SPECTRUM AND ANGULAR DISTRIBUTION EFFECTS FROM BEAM-PLASMA D-T FUSION. Lessor, D. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1975. Contract AT(45-1)-1830. 20p. Dep. NTIS $5.45.

The following five topics are discussed: (1) origin of energy spread in fusion neutrons, (2) magnitude of neutron energy spread from beam–plasma fusions, (3) techniques for calculation of fusion product particle spectra, (4) neutron spectra from fusion in isotropic plasmas, and (5) calculation of fusion neutron energy and angle distributions. (MOW)

8706 (COO-2218-35) PARAMETER STUDIES FOR A TWO-COMPONENT FUSION EXPERIMENT. Towner, H. H. (Illinois Univ., Urbana (USA)). 21 May 1975. Contract AT(11-1)-2218. 80p. Dep. NTIS $7.00.

Thesis.

The sensitivity of the energy multiplication of a two-component fusion experiment is examined relative to the following parameters: energy confinement time (tau/sub E/), particle confinement time (tau/sub p/), effective Z of the plasma (Z/sub eff/), injection rate (j/sub I/) and injection energy (E/sub I/). The Energy Research and Development Administration recently approved funding for such a fusion device (the Toroidal Fusion Test Reactor or TFTR) which will be built at the Princeton Plasma Physics Laboratory. Hence, such a parameter study seems both timely and necessary. This work also serves as an independent check on the design values proposed for the TFTR to enable it to achieve energy breakeven (F equals 1). Using the nominal TFTR design parameters and a self-consistent ion-electron power balance, the maximum F-value is found to be approximately 1.2 which occurs at an injection energy of approximately 210 KeV. The injector operation, i.e. its current and energy capability are shown to be a very critical factor in the TFTR performance. However, if the injectors meet the design objectives, there appears to be sufficient latitude in the other parameters to offer reasonable assurance that energy breakeven can be achieved. (auth)

8707 (COO-2218-39) CTR PLASMA ENGINEERING STUDIES. Progress Report, 1 September 1974–31 August 1975. Miley, G. H. (Illinois Univ., Urbana (USA)). 1 Jun 1975. Contract AT(11-1)-2218. 10p. Dep. NTIS $4.00.

During the past contract period this research was concerned with three main subtasks: (a) Neutral beam injection and charge exchange losses for mirror systems, (b) Two-component plasma calculations and fusion burn simulation, and (c) Studies of special problems such as cyclotron effects related to the use of advanced fusion fuels. Each of these areas is discussed in some detail. (MOW)

8708 (COO-2323-4) POTENTIAL WELL FORMATION IN ELECTROSTATIC CONFINEMENT DEVICES. Technical Progress Report. Cherrington, B. E.; Verdeyen, J. T. (Illinois Univ., Urbana (USA). Gaseous Electronics Lab.). 1975. 66p. Dep. NTIS $6.50.

The overall goal of this research program is to evaluate the feasibility of using inertial electrostatic forces to confine energetic plasmas capable of sustaining fusion reactions. A continuation of the theoretical studies has shown that highly energetic ions can be confined in larger spherical devices operating at high voltages and currents. A larger experimental device was designed to test the theoretical predictions and this device is under construction. Additional studies on a smaller spherical device were performed in order to determine the time of formation, time of decay, and stability of the negative potential wells and the multiple potential wells. (auth)

8709 (COO-2418-1) STUDY OF THE APPLICATION OF ADVANCED CONTROL SYSTEMS TO FUSION EXPERIMENTS AND REACTORS. Final Report. (Draper (Charles Stark) Lab., Inc., Cambridge, Mass. (USA)). May 1974. Contract AT(11-1)-2418. 76p. Dep. NTIS $7.00.

The work accomplished to date toward the formulation of an advanced control system concept for large-scale magnetically confined thermonuclear fusion devices is summarized. The work was concentrated in three major areas: (1) general control studies and identification of control issues, (2) exploration of possible direct interactions with AEC National Laboratories, and (3) identification of simulation requirements to support control studies. (MOW)

8710 (ERDA-39) 1974 REVIEW OF THE RESEARCH PROGRAM. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Controlled Thermonuclear Research). Jan 1975. 168p. Dep. NTIS $5.45.

The role of the Research Program in Controlled Thermonuclear Research, the activities that are contained within the Research Program, and summaries of the reports prepared by the study groups that analyzed the six activity areas that make up the Research Program are described. The recommendations by an "Overview Panel" are given. The recommendations are based on an analysis of the individual study group reports, consultations with CTR staff and field scientists, and on independent review of CTR program plans and needs. In some cases the recommendations of the Overview Panel are identical with study group recommendations and in other cases they are not. Some recommendations by the Overview Panel take into account factors and information that go beyond that available to the study groups. The five-year budget needed to accomplish the recommended Research Program

is discussed. The Overview Panel chose to normalize its budget recommendations to the actual FY 1975 Research Program budget, reflecting the fact that this is already determined. The budgets for subsequent years are then based on this starting point. The complete reports prepared by the six study groups are given. Each report is based on an analysis of the needs as dictated by the Magnetic Confinement Systems and Development and Technology Program Plans. (MOW)

8711 (IPP-4/123) DEVELOPMENT AND INVESTIGATION OF CO_2 LASERS WITH HOMOGENEOUS VOLUME DISCHARGE AT ATMOSPHERIC PRESSURE. Baumhacker, H.; Brinkschulte, H.; Fill, E.; Grigoriu, C.; Schmid, W. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Feb 1975. 155p. (In German). Dep. NTIS (US Sales Only) $10.75.

Different discharge configurations for exciting CO_2 laser gases were built and their parametric properties were investigated as functions of the discharge parameters. For electrode distances not exceeding 5 cm a discharge with pre-ionization from a weak discharge between one of the main electrodes and 2 or 4 auxiliary electrodes is most advantageous because of its simple set up. With this discharge type we achieved a maximum laser energy of 20 J from a volume of 0.9 l and a small signal gain of 0.035 cm^{-1}. We also developed a discharge with pre-ionization from UV radiation originating from many small spark gaps of a second discharge. This laser has very good and very reproducible oscillator properties, the maximum laser energy being 40 J from an active volume of 1.3 l. However, this type is rather unsuitable for use in a CO_2 laser amplifier chain owing to its poor reproducibility with respect to small signal gain. Of all systems the electron beam controlled discharge yields the best homogeneity and reproducibility of the discharge. We built a device with an active volume of $10 \times 10 \times 100$ cm^3 and for optimum discharge conditions we measured a gain of 0.043 cm^{-1} at a dissipated electrical energy of 1.8 kJ. (auth)

8712 (KIYI-74-22) ENERGETIC BALANCE OF SYSTEMS BASED ON SIMULTANEOUS USE OF THE FUSION AND FISSION REACTIONS. Kolesnichenko, Ya. I.; Reznik, S. N. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1974. 14p. (In Russian). INIS.

A look is taken at the possibility of simultaneously using fusion and fission reactions in a hybrid reactor. It is proposed that the hybrid reactor consist of a plasma system surrounded by a uranium–plutonium blanket. Neutrons which are formed during the fusion reaction are used both for the fission reaction and also for breeding plutonium-239. (SJR).

8713 (UCID-16778) DT FUSION NEUTRON IRRADIATING OF AI GLASS INSULATOR SAMPLE AT 800°C AND SLL FIBER OPTIC BUNDLES. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Apr 1975. Contract W-7405-ENG-48. 9p. Dep. NTIS $4.00.

Samples were irradiated in the LLL Rotating Target Neutron Source (RTNS). One sample was a Nb–1 percent Zr substrate upon which a glass coating consisting of SiO_2, BaO, and Al_2O_3 was fired. The substrate was 0.03 inch thick, and the coating was approximately 0.003 inch thick. Six fiber optic bundles were also irradiated at room temperature irradiation. A fluence of 10^{12} neutrons/cm^2 was used for two of the bundles and as high as possible fluence was used on the four other fiber optic bundles. The results are given. (MOW)

8714 (UCID-16814) CTR MIRROR PROGRAM PLANNING. Fowler, T. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jun 1975. Contract W-7405-eng-48. 21p. Dep. NTIS $4.00.

Verification of the basic scaling law of magnetic mirror confinement is discussed. Initial startup of a mirror reactor is another problem that must be overcome. The prospects for solving these two problems are discussed. (MOW)

8715 (UCRL-50021-74) LASER PROGRAM ANNUAL REPORT, 1974. Davis, J. I.; Clements, W. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1975. 519p. Dep. NTIS $13.60.

A separate abstract was prepared for each of the three sections of the report. (MOW)

For abstracts of individual sections see: 8716–8717, and 9034.

8716 (UCRL-50021-74, pp 1-27) PROGRAM OVERVIEW. Mar 1975.

In laser program annual report, 1974. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

The current status and future plans for gas and glass laser research are described. Some special systems studies described are: (1) power production with laser fusion, (2) laser engineering research facility, and (3) laser isotope separation. (MOW)

8717 (UCRL-50021-74, pp 29-65) LASER FUSION. Mar 1975.

In laser program annual report, 1974. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

The following areas of research are described: (1) current and planned laser facilities, (2) design considerations for solid-state laser irradiation facilities, (3) solid-state laser component development, (4) laser propagation and optical technology, (5) research related to solid-state lasers, (6) diagnostics hardware and software development, (7) laser-fusion target research and development, (8) laser plasma/fusion experiments, and (9) gas laser research and development for fusion. (MOW)

8718 LASER INITIATION OF THERMONUCLEAR REACTION IN INHOMOGENEOUS SPHERICAL TARGETS. Afanas'ev, Yu. V.; Basov, N.G.; Volosevich, P.P.; Gamalii, E.G.; Krokhin, O.N.; Kurdyumov, S.P.; Levanov, E.I.; Rozanov, V.B.; Samarskii, A.A.; Tikhonov, A.N. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). JETP Lett. 21: No. 2, 68-70 (20 Jan 1975).

We consider physical processes in thermonuclear targets for laser-induced thermonuclear fusion; these processes make it possible to obtain an energy gain $\sim 10^3$ at $E_{in} = 10^6$ J. (auth)

8719 MANUFACTURE OF DT-FILLED, HOLLOW GLASS MICROSPHERE, LASER TARGETS. Souers, P.C.; Tsugawa, R.T.; Stone, R.R. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Rev. Sci. Instrum. 46: No. 6, 682-685 (June 1975).

The fabrication of highly characterized DT-filled, hollow glass microsphere targets is described. The DT is loaded by gas permeation through the glass walls at 420°C. The DT fill is nondestructively measured by counting the emitted x rays with a proportional counter. The counter system is empirically calibrated by individually crushing microspheres in an ionization chamber. Outer diameters are measured optically with a split-image eyepiece. Wall thicknesses and sphericities are measured by light interference. For a 40-μ diam microsphere and 1-μ walls, we estimate our best absolute accuracies of measurement to be, o.d., ±1.6%; wall thickness at any point, ±10%; overall microsphere sphericity, ±7%. (auth)

8720 NONDESTRUCTIVE INSPECTION OF TRANSPARENT MICROTARGETS FOR LASER FUSION. Stone, R.R.; Gregg, D.W.; Souers, P.C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). J. Appl. Phys. 46: No. 6, 2693-2700 (June 1975).

The method is described for the nondestructive inspection of small (<100-μm outside diameter) hollow thin (<2-μm wall thickness) transparent shells used as laser-fusion targets. Utilizing the interference properties of light, this method enables measurements of sphericity and absolute wall thickness to accuracies better than ±10%. The equipment and calibration procedure are discussed. (auth)

8721 HOT-PLASMA INJECTOR USING A DIVERTOR BASED ON THE MAGNETIC-NEUTRAL-POINT DISCHARGE. Okamura, S.; Ohyabu, N.; Kawashima, N. (Tokyo Univ.). Nucl. Fusion; 15: No. 2, 207-212(Apr 1975).

The feasibility of a hot plasma injector using a divertor based on a magnetic neutral point discharge is studied experimentally. An intense plasma current is induced along a circular magnetic neutral line of the divertor, and the plasma is heated and injected inward to the central region. The plasma diffusing along the magnetic field lines is measured by a time-of-flight method using a pair of electrostatic double probes, and it is shown that the average energy of the diffusing plasma ions is 200 eV and the total amount of injected particles is 6×10^{16} particles per shot. The possible use of the divertor injector in a fusion reactor is discussed. (auth)

8722 POSITIONING OF RELATIVISTIC SUPERPINCHED BEAMS BY CONTROL OF THE ANODE RETURN CURRENTS. Kelly, J.G. (Sandia Laboratories, Albuquerque, New Mexico 87115). Appl. Phys. Lett. 26: No. 12, 665-667 (15 June 1975).

The centering of relativistic superpinched beams from large aspect ratio diodes ($r/d > 1$) onto small targets for studies of superpinches relies on a centering force, which is normally so weak that small diode asymmetries will cause the beam to pinch off axis. A new technique is described herein that increases the magnetic centering force by approximately a factor of 10^3 through control of the return current flow pattern on the anode surface. Preliminary experiments conducted on the Nereus accelerator ($V_b = 100$ kV, $I_b = 50$ kA, and $\tau = 50$ ns) have demonstrated that the superpinch can be reproducibly centered within 0.025 cm of the axis of a 2.54-cm-diam flat cathode. (auth)

8723 EUROPEAN FUSION RESEARCH PROGRAMME. Palumbo, D. Technol.-Nachr. Progr.-Inform.; No. 98, 2-9(Sep 1974).

Organization and programme of the coordinated fusion research in the European Community is outlined. After a survey of the associated laboratories of the member-states, the distribution of

the scientific staff, the financial basis and the management structure, the programme proposal for an experimental fusion reactor (as a prototype for a complete scaled Tokamak prototype) is discussed as well as the investigations on systems with inertial inclusion projected by Euratom-IPP Garching, including especially the projected contributions of the research centre Ispra. (AH/WL)

8724 POLOIDAL MAGNETIC FIELD IN A TORUS. Lo Surdo, C. (Associazione CNEN–EURATOM, Frascati, Italy). Nucl. Fusion; 15: No. 2, 271-275(Apr 1975).

A procedure is described which allows the evaluation of the vacuum magnetic field produced in a torus by a given system of azimuthal currents under appropriate boundary conditions. The solution is given in the form of a power series of ϵ, the inverse aspect ratio, which converges for any ϵ smaller than a well-defined upper bound ϵ^*. The first-order term of this series is explicitly computed by contour integration. (auth)

8725 CTR APPLICATIONS OF THE HIGH-DENSITY LINEAR THETA PINCH. Ellis, W. R. (Los Alamos Scientific Lab., NM). Nucl. Fusion; 15: No. 2, 255-270(Apr 1975).

Some general scaling laws for the (idealized) linear theta pinch are derived with the magnetic field strength as the independent variable. These scaling laws are used to calculate machine parameters, such as length, confinement time, magnetic energy storage requirements, etc. for five potential linear theta-pinch applications of interest to CTR: (a) a confinement experiment to achieve the Lawson criterion; (2) a power-producing theta-pinch reactor; (3) a power-producing laser-heated reactor; (4) a radiation and materials test facility (FERF); and (5) a fusion/fission hybrid reactor. In each case the advantages of operating at large values of magnetic field strength are shown quantitatively. Some potential problem areas for the high-field (and therefore high-density) linear theta pinch are identified and discussed. (auth)

8726 INTENSE, MIXED-ENERGY HYDROGEN BEAMS FOR CTR INJECTION. Berkner, K. H.; Pyle, R. V.; Stearns, J. W. (Univ. of California, Berkeley). Nucl. Fusion; 15: No. 2, 249-254(Apr 1975).

Present high-current ion sources for neutral injection experiments accelerate a mixture of atomic and molecular hydrogen species that are converted into neutral particles with different energies and neutralization efficiencies. Beam composition can have important effects on injection system efficiency, vacuum design, and first-wall loading. Beam composition measurements of the 20-keV LBL high-current sources are used to calculate the relative power in the various hydrogen and deuterium beam components expected at higher energies. (auth)

8727 REDUCTION OF PLASMA CONTAMINATION EFFECTS AND FIRST-WALL EROSION IN FUSION DEVICES. Kulcinski, G. L. (Univ. of Wisconsin, Madison); Conn, R. W.; Lang, G. Nucl. Fusion; 15: No. 2, 327-333(Apr 1975).

It is proposed to place a flexible, two-dimensional woven cloth between the plasma and the metallic vacuum wall. This cloth will act as a curtain and intercept practically all ions and neutral particles leaking from the plasma. The net result is a replacement of high-Z metallic impurities with low-Z carbon. The use of this cloth is discussed. (MOW)

8728 STRUCTURED FUSION TARGET DESIGNS. Kirkpatrick, R. C.; Cremer, C. C.; Madsen, L. C.; Rogers, H. H.; Cooper, R. S. (Los Alamos Scientific Lab., NM). Nucl. Fusion; 15: No. 2, 333-335(Apr 1975).

The work presented here is a comparative study made at LASL during the past few months of structured fusion target designs, with specific emphasis on energy input from an electron beam machine. However, the results are not limited to e-beam targets. (MOW)

8729 FEASIBILITY STUDY OF A HONEYCOMB VACUUM WALL FOR FUSION REACTORS. Cramer, S. N.; Oblow, E. M. (Oak Ridge National Lab., TN). Nucl. Fusion; 15: No. 2, 339-343(Apr 1975).

A preliminary evaluation of the feasibility of a honeycomb-wall concept was performed using a series of Monte-Carlo simulations of sputtering interactions in a cylindrical honeycomb cell. These calculations parameterize the length-to-diameter (L/D) of the cell and the sputtering yield data to determine: (1) the sensitivity of the design to sputtering data, (2) the optimum L/D of the cell, and (3) whether a significant reduction in sputtering yield results from honeycombing the wall. Calculations using various models are discussed. (MOW)

Wave Phenomena

Refer also to abstract 8693.

8730 AMPLITUDE-SPATIAL EFFECTS OF HIGH-INTENSITY RADIATION CONVERSION IN A LASER PLASMA. Gorokhov, A.A.; Dyatlov, V.D.; Medvedev, R.N.; Starikov, A.D.; Tuzov, V.G. JETP Lett. 21: No. 2, 49-50 (20 Jan 1975).

We investigated experimentally the transformation of the spectrum and the amplitudes of neodymium-laser radiation reflected from a plasma at intensities 10^{15}–3×10^{16} W/cm^2. Rather narrow regions of plasma luminosity were observed at the frequencies $2\omega_0$ and $3\omega_0/2$. Various mechanisms that can be responsible for the observed effects are considered. (auth)

8731 SIMPLE METHOD OF GENERATING AND COUPLING RF ENERGY TO A REACTIVE COLLISIONLESS PLASMA. Schumacher, R.W.; Holt, J.L.; MacKenzie, K.R. (Department of Physics, University of California, Los Angeles, California 90024). Rev. Sci. Instrum. 46: No. 6, 785-786 (June 1975).

A grounded grid oscillator is placed at the end of an electrical half-wave line and the plasma generating electrode at the other. This simple one-mode circuit enables the oscillator to efficiently deliver power in spite of frequency changes caused by the plasma reactance. (auth)

8732 HELICAL ANTENNA FOR EXCITING AZIMUTHALLY ASYMMETRIC ALFVÉN WAVES. Knox, S.O.; Paoloni, F.J.; Kristiansen, M. (Department of Electrical Engineering, Texas Tech University, Lubbock, Texas 79409). J. Appl. Phys. 46: No. 6, 2516-2520 (June 1975).

A new coupler for exciting azimuthally asymmetric Alfvén waves has been experimentally investigated. The coupler, which consists of four symmetrical helical straps wound around the vacuum vessel, is driven by a four-phase rf source. Waves excited by the coupler vary azimuthally as $\exp(jm\theta)$, where m can be chosen to be either $+1$ or -1. The coupler exhibits a strong propagation directionality and is capable of launching waves whose wavelengths differ considerably from its own. Loading measurements indicate an equivalent coil impedance, with a plasma load, of 1.2–3.9 Ω, which depends on the excitation frequency and the sign of m. The $m=-1$ wave was observed to propagate above and below ω_{ci} and was identified as the fast wave. The $m=+1$ wave was observed only below ω_{ci} as the slow wave. No $m=+1$ fast wave or $m=-1$ slow wave was observed. (auth)

8733 ABSORPTION OF CO_2 LASER RADIATION IN AN EXPLODED LITHIUM WIRE PLASMA. DeBoo, J.C.; Bach, D.R. (Nuclear Engineering Department, The University of Michigan, Ann Arbor, Michigan 48105). J. Appl. Phys. 46: No. 6, 2496-2503 (June 1975).

An absorption experiment was performed with a pulsed TEA CO_2 laser incident upon a partially ionized plasma created by exploding a 0.0025-cm-diam lithium wire in vacuum. Stark broadening of the Li I 6104-Å line and line intensity ratios of the same line to the Li II 5485–Å line were used to extract the density and temperature from time-resolved emission spectra. The neutral density was found from absorption measurements at 6328 Å and compared well with particle conservation calculations. In order to explain the strong observed absorption of both 10.6-μ and 6328-Å radiation, the plasma was assumed to consist of a hot peripheral region containing electrons and singly ionized lithium ions and a colder central region of excited neutrals. The model was supported by computer calculations and spectroscopic observations. Absorption of the 10.6-μ radiation was dominated by inverse bremsstrahlung in the field of ions and in the presence of neutrals. (auth)

8734 DAMPING-GROWTH TRANSITION FOR ION-ACOUSTIC WAVES IN A DENSITY GRADIENT. D'Angelo, N. (Danish Space Research Institute, Lyngby, Denmark); Michelsen, P.; Pécseli, H.L. Phys. Rev. Lett. 34: No. 19, 1214-1216 (12 May 1975).

A damping-growth transition for ion-acoustic waves propagating in a nonuniform plasma (e-folding length for the density l_n) is observed at a wavelength $\lambda\sim2\pi l_n$. This result supports calculations performed in connection with the problem of heating of the solar corona by ion-acoustic waves generated in the solar photosphere. (auth)

8735 MAXWELLIAN PLUS WATER-BAG MODEL: APPLICATION TO THE PROPAGATION OF LONGITUDINAL ELECTRON WAVES IN A PLASMA WITH MAXWELLIAN AND MONO-ENERGETIC SUPRATHERMAL ELECTRONS. Treguier, J. P.; Henry, D. (CNET, Centre de Recherches de Lannion, France). J. Plasma Phys.; 13: 193-216(Apr 1975).

A theoretical and experimental study is presented of the propagation of longitudinal electron waves in a collisionless, homogeneous, isotropic plasma, composed of Maxwellian and suprathermal electrons. Assuming the supra-thermal electrons are mono-energetic, the velocity distribution function is chosen as a Maxwellian plus water-bag distribution; then, using the method of residues (inverse Fourier-Laplace transform), the behavior of the electric field is found to be in good agreement with experimental results obtained for a plasma of Maxwellian and quasi-mono-energetic electrons. The plasma parameters can be deduced from the theoretical dispersion curves matching the experimental

points; they are found to agree well with those measured by electrostatic probes. Experimental values of damping and excitation coefficients are also compared with the theoretical. The results suggest that a longitudinal electron wave propagation experiment may be used as a powerful diagnostic tool to examine non-Maxwellian plasmas. (auth)

8736 NONLINEAR WAVES IN A HOT PLASMA BY LORENTZ TRANSFORMATION. Clemmow, P. C. (Cambridge Univ., Eng.). J. Plasma Phys.; 13: 231-247(Apr 1975).

Wave propagation in a hot, collisionless electron plasma (without ambient magnetic field) is analyzed by considering the frame of reference in which the field has no space dependence. It is shown that the governing equations are of the same form as those for a cold plasma, and are likely to have corresponding exact (nonlinear, relativistic) solutions. In particular, it is shown that there exists a solution representing a purely transverse, circularly polarized, monochromatic wave. Three approximate forms of the dispersion relation of this wave are obtained explicitly, the first being valid when the temperature correction is small, the second applying to weak waves, and the third to strong waves. Purely longitudinal waves are also discussed. (auth)

8737 FORMATION AND RECURRENCE OF ION WAVE SOLITONS. Watanabe, S. (Paris Univ., Orsay, France). J. Plasma Phys.; 13: 217-230(Apr 1975).

The interaction between an ion wave and its second harmonic is discussed theoretically, on the basis of coupled-mode equations derived from the Korteweg-de Vries equation. Using an exact solution of the coupled-mode equations, a numerical analysis is given of the properties of the solutions; and it is shown that superposition of two waves can describe the formation of two solitons, the interaction between them, and the recurrence of an initial state. The theory can explain completely recent experimental results on ion wave solitons excited by a continuous sine wave. (auth)

8738 PARAMETRIC EXCITATION OF DRIFT WAVES BY ION–ION HYBRID FIELDS. Satya, Y.; Sen, A.; Kaw, P. (Physical Research Lab., Ahmedabad, India). Nucl. Fusion; 15: No. 2, 195-200(Apr 1975).

The behavior of low-frequency drift waves in a two-species plasma under the influence of a large-amplitude spatially uniform electric field oscillating at the ion-ion hybrid frequency and applied across an ambient static magnetic field was studied. The threshold powers for the parametric excitation of these drift waves are calculated and the characteristics of the dispersion relation near threshold and well above threshold are examined. At large applied powers (much above threshold), interesting modifications of the natural drift modes are found. (auth)

8739 LOW FREQUENCY WAVES IN A BEAM-PHASE SYSTEM. Nyack, C. A.; Christiansen, P. J. (West Indies Univ., Barbados). Plasma Phys.; 17: No. 4, 249-260(Apr 1975).

It is found that three sets of waves exist in the beam-plasma system, one of which has been investigated previously by Vermeer et al (Vermeer, A. and Kistemaker, J. (1970) Plasma Phys., 12, 95). The other two waves, the second ion cyclotron wave and the ion sound wave, are described. It is shown that for the first regime of the beam-plasma interaction the excitation mechanism in both cases is a coupling of the slow cyclotron wave on the beam with the plasma waves concerned. In the second regime the predominant excitation mechanism is a decay of the large amplitude electron plasma wave into another electron wave and an ion wave. (auth)

8740 ANALYTICAL BGK MODES AND THEIR MODULATIONAL INSTABILITY. Schamel, H. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen, Ger.). J. Plasma Phys.; 13: No. 1, 139-145(Feb 1975).

Physically acceptable solutions of the time-independent Vlasov-Poisson system are found by applying a method which is analogous to the soliton method in Korteweg-de Vries theory. Wave solutions for small-amplitude Langmuir and ion acoustic waves are derived, in which the nonlinearity is determined by trapped electrons. The class of weakly distorted waves is shown to be modulationally unstable. (auth)

8741 VARIATIONAL CALCULATIONS FOR RESONANCE OSCILLATIONS OF INHOMOGENEOUS PLASMAS. Peng, Y. K. M. (Stanford Univ., CA). J. Plasma Phys.; 13: 283-298(Apr 1975).

The electrostatic resonance properties of an inhomogeneous plasma column are treated by the Rayleigh-Ritz method. In contrast to Parker, Nickel & Gould (Parker, J. V., Nickel, J. C. & Gould, R. W., 1964, Phys. Fluids, 7, 1489), who carried out an exact computation, we use a description of the RF equation of motion and pressure term that allows us to express the system of equations in Euler-Lagrange form. The Rayleigh-Ritz procedure is then applied to the corresponding Lagrangian, to obtain approximate resonance frequencies and eigenfunctions. An appropriate set of trial coordinate functions is defined, which leads to frequency and eigenfunction extimates in excellent agreement with the work of Parker et al. (auth)

8742 HYDRODYNAMIC THEORY OF SURFACE-WATER FLUCTUATIONS IN INHOMOGENEOUS PLASMA. Aliev, Y. M.; Vukovic, S.; Gradov, O. M.; Kyrie, A. Y. J. Plasma Phys.; 13: 273-282(Apr 1975).

The fluctuation spectrum of the surface waves in a semi-infinite plasma, and in a plasma cylinder, with an inhomogeneous boundary layer is investigated. It is shown that the correlations of the surface waves are dependent on temperature and density distributions in the boundary layer. The correlation function is determined by temperature values in the points of transition layer, where the longitudinal dielectric permeability becomes equal to zero. Dependence of the obtained correlation function on coordinates, in the electrostatic limit, is characterized by the complex correlation length, which is fully determined by the inhomogeneity of the plasma density near the boundary. (auth)

8743 STABILITY OF NONLINEAR WAVES COEXISTING WITH PLASMA BEAMS. Infeld, E.; Rowlands, G. (Inst. of Nuclear Research, Warsaw). J. Plasma Phys.; 13: No. 1, 173-187 (Feb 1975).

The stability of one-dimensional stationary waves set up by two counter-streaming beams of electrons in a background of stationary ions is examined. The perturbations considered are long-wave in a direction perpendicular to the wave. The presence of a uniform magnetic field in the direction of the wave and the effect of a perpendicular pressure are taken into account. In the long-wavelength limit growth rates are diminished by the nonlinear wave. When the amplitude of this wave tends to its maximum value, the growth rates tend to zero. Thus the wave has a stabilizing effect for long-wave perturbations. Three-dimensional effects lead to additional instabilities which are also quenched by the nonlinear wave, but not as fast as the one-dimensional calculation indicates. For nonlinear wave amplitude tending to maximum value ($a \to 1$), the three-dimensional mode has growth rate $\sim(1 - a^2)$, whereas for the one-dimensional mode it is $\sim(1 - a^2)^{\frac{1}{2}}$. Thus the results shed some light on the three-dimensional computer simulations of Morse & Nielson (Morse, R. L. & Nielson, C. W., 1969, Phys. Rev.Lett., 23, 1087), which in fact lead to a mode much more unstable in three dimensions than in one. (auth)

8744 STABILITY OF NONLINEAR MAGNETO-SONIC WAVES IN A COLLISIONLESS PLASMA. Infeld, E.; Rowlands, G. (Inst. of Nuclear Research, Warsaw). J. Plasma Phys.; 13: No. 1, 189-191(Feb 1975).

Demchenko & Hussein (Demchenko, V. V. & Hussein, A. M., 1973, J.Plasma Phys. 10, 459) discussed some properties of nonlinear magnetosonic waves in a collisionless plasma. The relevant equation describing the space dependence x of the magnetic field may be written in the form $d^2y/dx^2 + f(y) = 0$ (1), where f(y) is nonlinear function of y only. Demchenko & Hussein considered solutions adjacent to one of the periodic solutions by writing $y = y_p(x) + y(x)$, where y_p is the periodic solution and y a measure of the deviation. In the linear approximation y satisfies $d^2y/dx^2 + f'(y_p)\, y = 0$ (2), where the dash denotes differentiation with respect to y_p. They were unable to solve (2), and obtained an approximate solution by making two approximations. The first point of this note is to show that (2) may be solved exactly in terms of y_p, and that the exact solution is of the form $y = AQ_1(x) + xCQ_2(x)$ (4), where Q_1 and Q_2 are periodic functions, and A and C the arbitary constants of integration. It is shown that the most general solution to (2) is of the form (4), not of the form obtained by Demchenko & Hussein, namely $y = \exp(Kx)P_1(x)P_1(x) + \exp(-Kx)P_2(x)$. From this it is concluded that the incorrect result obtained by Demchenko & Hussein is due to their approximation scheme. Further, even a knowledge of the correct form of solution (4) does not lead to any information on the stability of these nonlinear waves. (auth)

8745 NEW AND EXTENDED CONCEPT FOR REFLECTION AND TRANSMISSION COEFFICIENTS FOR WAVES PROPAGATING IN ISOTROPIC AND ANISOTROPIC PLASMA. Heading, J. (University Coll. of Wales, Aberystwyth, Eng.). J. Plasma Phys.; 13: No. 1, 147-165(Feb 1975).

It is common practice to define reflection and transmission coefficients for waves propagating through isotropic and anisotropic inhomogeneous plasma in terms of coefficients of waves existing within homogeneous regions of the plasma below and above the inhomogeneity. This concept is shown to be very restricted, and corresponding coefficients are defined for solutions existing within the inhomogeneous regions of the plasma. The extended concept is shown to satisfy conditions usually associated with the more common definitions, notably energy conservation and reciprocity. The

theory is developed using integral equations and matrix theory, and special precautions are taken so that the results extend from the inhomogeneous plasma into free-space domains. (auth)

8746 NONLINEAR INTERACTION BETWEEN A MONOCHROMATIC ION-ACOUSTIC WAVE AND A PLASMA. Indykul, V.P. Sov. Phys.—Tech. Phys. 19: No. 9, 1157-1159 (Mar 1975).

The nonlinear interaction between a monochromatic, finite-amplitude ion-acoustic wave and a collisionless nonisothermic plasma is considered. The nonlinear damping and frequency shift are obtained. The nonlinear damping of the ion-acoustic wave is due primarily to the ions, whose interaction with the wave is much stronger because the resonant-ion period is longer than the electron period. The nonlinear frequency shift of the ion-acoustic wave due to the interaction with the resonant plasma particles is determined primarily by the electrons. (auth)

8747 MODULATION OF MICROWAVES BY DENSITY FLUCTUATIONS IN A PLASMA. Dushin, L.A.; Serikov, A.V.; Skibenko, A.I.; Krivorukov, E.V.; Fomin, I.P. Sov. Phys.—Tech. Phys. 19: No. 9, 1163-1167 (Mar 1975).

To determine the parameters of a fluctuating plasma from modulation of electromagnetic waves, we have investigated the frequency spectrum and the plasma particle density by spectral analysis of fluctuations in the level of a microwave signal transmitted through the plasma. Analytical relations are obtained for the partial and integrated modulation coefficients for the regular and random components of density and on the effective collisions frequency averaged over the path. The experimental arrangement allows investigation of the temporal variation of the spectrum and the level of the high-frequency signal transmitted through the plasma in the frequency range 0.05-5 MHz, by recording short samples at different time intervals of the pulse. Spectral analysis of fluctuations in the microwave signal level ($\lambda = 8$ mm) gives the spectrum and the level of plasma density oscillations whose mean value falls in the range $5 \cdot 10^{11}$ to cm^{-3}. The range of characteristic frequencies of the density oscillations is 0.05 to 1 MHz. The level of relative density fluctuations in a 40 kHz band near the characteristic maxima of the oscillations is 2 to $7 \cdot 10^{-3}$. The high-frequency spectra are compared with the signal from a zero-bias double probe. (auth)

8748 OBSERVATION AND STUDY OF ELECTROMAGNETIC WAVE GENERATION IN METALS USING NANOSECOND PULSES OF LASER LIGHT: CASE OF ALFVÉN WAVES IN BISMUTH. Hu, P.; Narayanamurti, V.; Dynes, R.C. (Bell Laboratories, Murray Hill, New Jersey 07947). Phys. Rev. Lett. 34: No. 16, 1015-1018 (21 Apr 1975).

We have observed the generation of an electric field pulse by a nanosecond laser pulse incident on a bismuth surface in an external magnetic field. The propagation velocity and the de Haas-van Alphen-type oscillations are found to be consistent with those expected for Alfvén-wave propagation. This technique may well be a general way of exciting a variety of electromagnetic waves in a plasma. (auth)

8749 INDUCED SCATTERING AND CONNECTED SPECTRA OF LANGMUIR TURBULENCE AND PARTICLES IN A PLASMA. Botsman, V. I.; Kats, A. V.; Kontorovich, V. M. (Scientific-Research Inst. of Metrology, Kharkov). Dokl. Akad. Nauk SSSR; 220: No. 5, 1053-1056(11 Feb 1975). (In Russian).

Because of the existence of numerous instabilities, a non-equilibrium plasma readily goes over into a turbulent state, where a large number of waves in the plasma appear to be excited. If the number of waves excited in a plasma is not too large, their interaction appears to bear the character of collisions, and can be described by kinetic equations, where it is possible to have situations with some one type of collision predominating in a definite region of energies. A process of induced scattering is considered as predominant in the interaction of plasmons and ions. Under these conditions a solution is obtained to a bound system of kinetic equations that determines both the spectrum of the stationary plasmenon turbulence and also the particle distribution. The spectra of plasmonons and ions turn out to be bound because of induced scattering. Over a rather wide interval (from thermal velocity of the ions to thermal velocity of the electrons) the ion spectrum may differ substantially from an equilibrium spectrum. The change in the distribution of plasmonons can serve as a source of information about the parameters of the plasma. (SJR)

ENGINEERING

8750 (SAND-74-0089) SANDIA LABORATORIES TECHNICAL CAPABILITIES: SYSTEMS ANALYSIS. Lundergan, C. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1975. Contract AT(29-1)-789. 17p. Dep. NTIS $4.00.

The systems analysis capabilities at Sandia Laboratories are summarized. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs. (auth)

8751 PROCEEDINGS OF THE ELEVENTH ANNUAL MEETING OF THE SOCIETY OF ENGINEERING SCIENCE, DURHAM, NORTH CAROLINA, NOVEMBER 11–13, 1974. Dvorak, G. J. (ed.). Durham, NC; Duke University (1974). 390p. (CONF-741128-).

Abstracts of the more than 170 papers presented at the conference are presented. The scope of the meeting covered a number of subjects in the fields of solid and fracture mechanics, fluid mechanics, biomechanics, solid state physics, and applied mathematics. (TFD)

Energy Conversion

Refer also to abstracts 9039–9041, and 9044–9045.

8752 (GA-7449) RADIOISOTOPE SPACE POWER GENERATOR. Annual Summary Report for the Period October 1, 1965–September 30, 1966. Baker, F.; Elsner, N.; Godsin, W.; Leedy, R.; Pidd, R.; Shevlin, R.; Steeger, E.; Ream, J. (Gulf General Atomic Co., San Diego, Calif. (USA)). 1966. Contract AT(04-3)-167. 172p. Dep. NTIS $11.75.

Declassified 5 Sep 73.

Research progress in the development of the ISOTEC radioisotope thermoelectric generator is summarized. (TFD)

8753 (GA-9503) SUMMARY OF THE GROWTH POTENTIAL OF THE ISOTEC GENERATOR. Steeger, E. J.; Brislin, R. J. (Gulf General Atomic Co., San Diego, Calif. (USA)). Jun 1969. Contract AT(29-2)-2564. 34p. Dep. NTIS $4.75.

Declassified 6 Sep 1973.

Methods for increasing the power output of the ISOTEC generator are discussed. They include (1) maintaining the current number of couples per panel and increasing the total number of panels in the generator; and (2) maintaining the current number of panels and increasing the number of couples in each panel. (TFD)

8754 (MND-2062-6-8) SNAP 29 POWER SUPPLY SYSTEM. Seventh Quarterly Progress Report, March 31, 1968–June 30, 1968. (Martin Marietta Corp., Baltimore, Md. (USA)). Jul 1968. Contract AT(29-2)-2062. 263p. Dep. NTIS $16.25.

Declassified 30 Aug 1973.

Research progress on the SNAP 29 program to develop and demonstrate a radioisotope thermoelectric generator system is reported. (TFD)

8755 (TID/SNG-9) POWER SYSTEM SELECTION. Pellmann, R.; Lamnin, M.; Freedman, S. I.; Baker, J. (General Electric Co., Philadelphia, Pa. (USA). Missile and Space Div.). 1 Jan 1967. 31p. Dep. NTIS $4.75.

For Jet Propulsion Lab., Pasadena, CA.

Results are presented of a study aimed at the selection of a method for RTG electrical output regulation for use in the Voyager power system. A partial shunt regulator configuration is recommended since it provides reduction in weight, electronic complexity, and thermal dissipation of excess power. The recommended configuration is one in which a separate partial shunt regulator is used for each RTG. All regulators operate in unison from a common error amplifier source. The relationship of RTG temperature and power characteristics is discussed. A comparative analysis is made of RTG temperature performance. Analyses of several regulator candidates are presented, considering such items as thermal and physical characteristics, electronic complexity, and ease of fault sensing and fault removal. Considerations are given to regulator failure modes and effects and implementation of redundancy. Finally, conclusions are presented relating to the selection of the recommended approach and plans for further effort. (auth)

8756 (TID/SNG-10) PRELIMINARY SPACECRAFT THERMAL INTEGRATION ANALYSIS. Mantia, C. P.; Freedman, S. I. (General Electric Co., Philadelphia, Pa. (USA). Missile and Space Div.). 15 Dec 1966. 20p. Dep. NTIS $4.00.

For Jet Propulsion Lab., Pasadena, CA.

Preliminary evaluation of the thermal integration of RTG's with the Voyager Spacecraft Bus has resulted in the following conclusions: prior to shroud separation, RTG temperatures will not increase more than 35°F over free space equilibrium temperatures; no directed air precooling of the RTG's is required; prior to shroud separation, electronic equipment temperature increases will not exceed 11°F in comparison with a solar-powered spacecraft; shroud temperature gradients are not expected to exceed 1°F/inch. Maximum local shroud temperatures will not exceed 136°F; and to maintain the electronics during prelaunch at a maximum temperature of 120°F will require air flows of 4 lb/s at inlet temperatures of 70°F. (auth)

8757 TWO-WATT RADIOISOTOPE POWER GENERATORS FOR UNDERWATER APPLICATIONS. Caputo, R. S.; Truscello, V. C. (Jet Propulsion Lab, Pasadena, CA). pp 637-645 of 9th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Society of Mechanical Engineers (1974).

From 9th Intersociety Energy Conversion Engineering Conference; San Francisco, California, USA (26 Aug 1974). See CONF-740805-.

The Navy has undertaken a program to develop a low cost, highly reliable radioisotope fueled thermoelectric generator (RPG) for use in an undersea, volume constrained application, having a mission life of 20 years. For reasons of weight, volume and lifetime considerations, plutonium-238 has been selected as the fuel. In addition to providing a minimum of 2 watts(e), the RPG is required to maintain its unconditioned voltage in the range of 6.2 to 8.0 volts over the 20 year operational period. The total RPG volume is limited to containment within a right circular cylinder envelope 8 inches in diameter and 6 inches in length. It is desired, however, that the dimensions be limited to 3 inches in diameter and 4 inches long. Because of the high cost of plutonium and its limited availability, it is important that the amount of plutonium fuel be minimized within the constraint of high reliability. An overall end-of-life (20 years) RPG efficiency of 4% is anticipated as a minimum goal. In order to enable the production of an RPG having the highest reliability and confidence level for a 20 year operational lifetime, the selection of the thermoelectric material and thermopile configuration choice was to be based on current technology, requiring no development effort. The Jet Propulsion Laboratory set out to determine whether the goals of the program were obtainable and, if so, which materials and configuration were optimal for this application. (auth)

8758 NEUE ENERGIESYSTEME FUER DIE RAUMFAHRT. Energiequellen, Energiewandler, Energiespeicher. (New energy systems for space-flight. Energy sources, energy converters, energy reservoirs). Peschka, W. Das Wissenschaftliche Taschenbuch. Muenchen, F. R. Germany; Goldmann (1972). 214p.

Space-flight needs sources, converters, and reservoirs of energy. This book gives a survey on used and possible systems. After a short annotation about energy supply and an introduction to unconventional energy sources the fundamentals of energy converters, such as electrochemical, photoelectric, thermoelectric, thermionic, and mechanoelectric converters, are presented. Solar-electric and solar-thermic systems are briefly discussed. Among the nuclear-thermic energy systems the SNAP-batteries and their different principles are described in detail. Some tendencies of the future development of on-board energy systems and of propulsion systems are also presented. (GE)

Facilities and Equipment

Refer also to abstracts 8613–8614, 9008, 9342, and 11083.

8759 (CONF-750617-8) TESTS AT ROOM TEMPERATURE AND 1100°F ON A 4" SCH 10 ELBOW-PIPE ASSEMBLY SUBJECTED TO IN-PLANE MOMENT LOADING. Griffith, W. I.; Rodabaugh, E. C. (Battelle Columbus Labs., Ohio (USA)). 1975. 37p. Dep. NTIS $5.00

From second ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

For Holifield National Lab., Oak Ridge, TN.

Curved pipe (or girth butt welding elbows) with moment loadings have a complex stress distribution, even in the elastic regime. Theories and tests have shown that these complex stress distributions arise from the tendency for the elbow cross-section to deform. For thin-wall elbows with relatively small bend radius, both theories and tests show that, when subjected to in-plane moments, the maximum stress occurs in the hoop direction at the "neutral axis". This stress can be many times as high as the nominal stress in equivalent radius and wall thickness straight pipe. While a few tests on curved pipes have been run at room temperature with loads extending into the plastic regime, no test data at elevated

temperatures are available. This report describes the tests and results for a test assembly using a 4-in. Sch. 10, 6-in. bend radius elbow. The test assembly was made of 304 stainless steel, ORNL Heat No. 9T2796, and was annealed at 2000°F after fabrication. The assembly was tested at room temperature and at 1100°F by applying weights to produce an in-plane moment loading. Displacements and strains were measured. The results are presented and discussed in relationship to relatively simple theories for elastic and plastic/creep behavior of elbows. (auth)

8760 (CONF-750617-10) DESIGN AND ANALYSIS OF MULTIAXIAL CREEP TESTS. Mallett, R. H.; Dhalla, A. K.; Yocolano, J. T. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1974. Contract AT(11-1)-3045. 32p. Dep. NTIS $5.00.

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

A procedure is described for presenting the complete data as obtained from tests of thin-walled tubular creep test specimens. Thereafter, a procedure for processing the data is presented. The processed data is based in part upon results of detailed inelastic finite element analyses performed to determine uniform and constant stress quantities and effective gage lengths. (TFD)

8761 (SC-DR-68-215) TERRADYNAMICS: A STUDY OF PROJECTILE PENETRATION OF NATURAL EARTH MATERIALS. Colp, J. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1968. 61p. Dep. NTIS $6.25.

Sandia's terradynamic program has two purposes: (1) to develop a knowledge of the basic physical phenomena involved during projectile penetration, and (2) to obtain sufficient data from penetrations into natural earth materials to develop an empirical equation to predict depth achieved. Laboratory experiments using water, sand, silt, gelatin, and stacked steel rollers have been used to study penetration mechanisms. Field tests into natural earth materials were used to confirm laboratory observations. An empirical equation that predicts penetration depth with 20% accuracy has been developed from the results of over 500 tests into granite, sandstone, limestone, tuff, glacier ice, permafrost, playa, desert alluvium, gypsite, beach sand, moist clay, saturated bay mud, and water. (auth)

8762 (TID/SNM-22) S10P4 SYSTEM PERFORMANCE. (Minnesota Mining and Mfg. Co., St. Paul (USA). Electrical Products Group). [nd]. 16p. Dep. NTIS $4.00.

8763 (UCID-16457-74-4) H-DIVISION QUARTERLY REPORT, OCTOBER–DECEMBER 1974. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. Contract W-7405-Eng-48. 74p. Dep. NTIS $6.75.

A separate abstract was prepared for each of the six sections of the report. (TFD)

For abstracts of individual sections see: 8865, 8879, 8880, and 9322–9324.

8764 (Y-EC-289) BRITTLE FAILURE OF A LARGE 30,000 PSI ISOSTAT AND ITS TWIN VESSEL COMPARISON ANALYSIS. Pohto, H. A. (Oak Ridge Y-12 Plant, Tenn. (USA)). Jan 1975. Contract W-7405-eng-26. 32p. (CONF-750704-1). Dep. NTIS $4.75.

From 2nd international conference on high pressure engineering; Brighton, UK (8 Jul 1975).

At Oak Ridge, Tennessee, twin isostats 30-in (0.762 m) ID by 120-in (3.048 m) depth, designed for 30,000 psi (207 MPa) operating pressure, were installed. Just prior to placing the second vessel in operation, the first isostat failed abruptly at the closure thread root. Strain gage data from the closure thread roots of the second vessel obtained over a several year time interval compared remarkably to calculated results. Similar post-failure calculations of the ruptured vessel, operating at the original conditions, showed that failure was imminent and predictable. Methods for determining the fatigue life and inspectional findings of both vessels are discussed. (auth)

8765 LIQUID METAL OPERATED HEAT EXCHANGER. Petrek, J. P. (to U.S. Atomic Energy Commission). US Patent 3,868,994. F28d7/12; F28f9/02. 4 Mar 1975. Filed date 26 Feb 1973. 9p.

PAT-APPL-355,851.

This invention relates to a heat exchanger arrangement of the shell and tube type especially adapted for the use of high temperature liquid metal as a heating medium. The arrangement incorporates a tube bundle comprising a plurality of bayonet tube assemblies through which the liquid metal is circulated in indirect heat exchange relation with vaporizable fluid that flows through the shell. The tube assemblies incorporate a double walled bayonet tube containing a gas space which provides a thermal barrier to minimize heat loss from the heating medium. Various embodiments of evaporator and evaporator-superheater organizations utilizing the heat exchanger arrangement are described. (auth)

8766 ENERGY ABSORBING STRUCTURE IN A STEAM GENERATOR. Van Weelderen, A. B. (to U. S. Atomic Energy Commission). US Patent 3,866,786. B65d3/22; B65d25/14. 18 Feb 1975. Filed date 22 Sep 1972. 3p.

PAT-APPL-291,477.

This invention concerns an energy absorbing liner structure at the inside of a sodium-steam generator wall which consists of two concentric thin-walled cylinders. Thin-walled tubes filled with tight compacted steel wool are fitted in the space between the two concentric cylinders. This energy absorbing structure will prevent damage to the vessel wall resulting from the effects of a sodium-water reaction. (auth)

8767 EXPLOSION DRIVEN MAGNETIC GENERATOR WITH A MATCHED INDUCTIVE LOAD. Gerasimov, L.S. Sov. Phys.—Tech. Phys. 19: No. 9, 1226-1230 (Mar 1975).

The conditions for maximum energy transfer and peak power from an explosion-driven magnetic generator (EMG) acting on an inductive load are considered for three circuits: transformerless, with transformer outside the explosion chamber, and transformer inside the explosion chamber. Optimum regimes are described. The parameter ranges are determined for which one of the circuits is preferable to the other two. (auth)

Lasers

8768 (EGG-1183-5054) KALVAR FILM REPORT. Manning, J.; Klingler, Q. (EG and G, Inc., Los Alamos, N. Mex. (USA)). Oct 1974. 27p. Dep. NTIS $4.00.

For Los Alamos Scientific Lab., NM.

This report describes the results of an investigation of certain characteristics of Kalvar Film that are relevant to its use for mapping the energy density distribution in pulsed laser beams are described. The minimum detectable energy density of CO_2 laser radiation was approximately 0.75 J/cm^2. The threshold for film damage was approximately 3.1 J/cm^2. The dynamic range was approximately 3. An interference pattern containing more than 100 lines per mm was recorded by the film. (auth)

8769 (UCID-16802) SPATIAL FILTER ANALYSIS OF GAUSSIAN BEAMS WITH SINUSOIDAL AMPLITUDE MODULATION. Weaver, H. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1973. Contract W-7405-Eng-48. 23p. Dep. NTIS $4.25.

This report analyzes a spatial filter subsystem for the kilojoule laser system. It is assumed that the oscillator output beam has a Gaussian profile with cosinusoidal structure imposed on it. The report indicates how to choose the optical elements of the spatial filter system to remove this structure and how to analyze other forms of structure. (auth)

8770 (UCRL-76355) THERMO-OPTICAL LIMITATIONS ON HIGH AVERAGE POWER DYE LASERS. Peterson, O. G.; Pease, A. A.; Pearson, W. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 May 1975. 20p. (CONF-750520-5). Dep. NTIS $4.00.

From IEEE Optical Society of American conference on laser engineering and applications; Washington, District of Columbia, USA (28 May 1975).

The effects of thermally-induced prism-inhomogeneities in dye laser windows are discussed. A few potential solutions to the problem are presented. (TFD)

8771 (UCRL-Trans-10717) PROSPECTIVE STUDIES OF THE MOLECULAR POWER LASER. Second Quarterly Report. (Compagnie Generale d'Electricite (CGE), 91–Marcoussis (France)). Nov 1973. Translation of Etudes Prospectives sur le Laser Moleculaire de Puissance. 2eme Rapport Trimestriel. 40p. Dep. NTIS $5.00.

Research progress is reported on molecular power lasers including the study and comparison of the different possibilities of shaping laser pulses at 10.6 μ; study of the amplification of short laser pulses (1 to 2 ns) at 10.6 μ; and producing a model of a high-power CO_2 chain (performance target: 50 GW in 1 ns). (TFD)

8772 THEORY OF THE LASER THRESHOLD OF A HOMOGENEOUS HEAVILY DOPED SEMICONDUCTOR SUBJECTED TO A QUANTIZING MAGNETIC FIELD. Birzhis, S. V.; Godenko, L. P.; Mashkevich, V. S. Sov. J. Quant. Electron.; 4: No. 1, 36-40(Jul 1974).

Translated from Kvantovaya Elektron. (Moscow); 1: No. 1, 69-77(Jan 1974).

The theory of the threshold of a heavily doped and compensated semiconductor subject to a uniform magnetic field is developed. It is assumed that the valence band has a density of states tail, and that the conduction band is parabolic. The magnetic field is

taken to influence only the conduction band states. An exponential decrease of threshold pumping energy with increasing magnetic field is found. (Elec.Electron.Abstr.)

8773 NEW THEORY OF INTERNAL Q SWITCHING IN SEMICONDUCTOR LASERS. Grundorfer, S.; Adams, M. J.; Thomas, B. (University Coll., Cardiff, Wales). Electron. Lett.; 10: No. 17, 354-356(22 Aug 1974).

By considering optical-confinement effects in semiconductor lasers, a new theory is presented of transient phenomena in these devices. It is shown that a partial loss of confinement at high injection levels, when combined with the effects of saturable absorption can satisfactorily account for Q-switching. (Elec. Electron.Abstr.)

8774 INFLUENCE OF INTENSITY PULSATIONS ON THE STIMULATED EMISSION SPECTRUM OF A SEMICONDUCTOR LASER. Allakhverdyan, R. G.; Morozov, V. N.; Suchkov, A. F. Sov. J. Quant. Electron.; 4: No. 1, 55-57(Jul 1974).

Translated from Kvantovaya Elektron. (Moscow); 1: No. 1, 102-107(Jan 1974).

It is shown that in the presence of undamped pulsations (spikes) the spontaneous emission gives rise to a multimode stimulated emission from a semiconductor laser. This occurs because strongly modulated spontaneous emission in a given mode influences the stimulated emission in that mode, compensating the difference between the mode losses in the intervals between the light pulses. There is a consequent raising of the time average intensities of the neighboring modes. The mulitmode stimulated emission near the threshold of semiconductor lasers can be interpreted in terms of this mechanism. (Elec.Electron.Abstr.)

8775 POSSIBILITY OF A LASER EFFECT IN RUBY BY EXCITING ELECTRON–HOLE PAIRS. Shilov, Yu.I. Sov. Phys.-Solid State (Engl. Transl.); 16: No. 8, 1582(Feb 1975).

Translated from Fiz. Tverd. Tela; 16: No. 8, 2428-2430(Aug 1974).

The kinetics of level population of Cr atoms in ruby during excitation of electron-hole pairs in the sample under the action of incident radiation sufficiently intense to ionize the matrix are considered. The method of excitation is not specified. It is assumed that an equilibrium distribution in the sample of the source of the pairs with a Q facture in cm^{-3}/sec^{-1} already exists. (TFD)

8776 SPATIAL DISTRIBUTION OF THE LIGHT INTENSITY IN THE INJECTION LASERS. Hasuo, S.; Ohmi, T. (Tokyo Inst. of Tech.). Jap. J. Appl. Phys.; 13: No. 9, 1429-1434(Sep 1974).

Spatial distribution of the light intensity and the population inversion density along the length of the laser cavity are discussed with the assumption of the uniform excitation current, and are shown to vary slowly compared to those obtained assuming the uniform population inversion density. (Elec.Electron.Abstr.)

8777 CONTINUOUS OPERATION OVER 2500 h OF DOUBLE HETEROSTRUCTURE LASER DIODES WITH OUTPUT POWERS MORE THAN 80 mW. Nakada, O.; Chinone, N.; Nakamura, S.; Nakashima, H.; Ito, R. (Hitachi Ltd., Tokyo). Jap. J. Appl. Phys.; 13: No. 9, 1485-1486(Sep 1974).

Double heterostructure laser diodes of very-low-mesa-stripe geometry with an undoped $Ga_{0.95}Al_{0.05}As$ active layer demonstrated fairly long continuous operating lifetimes at output powers of more than 80 mW. The exclusion of inhomogeneities or defects from the active layer proved to be effective for preventing the drastic inhomogeneous degradation even at such high output levels. (Elect. Electron. Abstr.)

8778 OPTICAL COATINGS FOR HIGH ENERGY ZnSe LASER WINDOWS. Rudisill, J. E.; Braunstein, M.; Braunstein, A. I. (Hughes Research Labs., Malibu, CA). Appl. Opt.; 13: No. 9, 2075-2080(Sep 1974).

Surface finishing procedures for polishing ZnSe windows are described. A design diagram for 2-layer antireflection coatings for operation at 10.6 mu m is given. Spectral transmission, absorption, reflectance, and scattering are among the measurements reported for coatings which include pairs from ThF_4, BaF_2, ZnS, and ZnSe. (Elect. Electron. Abstr.)

8779 MULTI-HETERO-AlGaAs LASER WITH INTEGRATED TWIN GUIDE. Suematsu, Y.; Yamada, M.; Hayashi, K. (Tokyo Inst. of Tech.). Proc. IEEE (Inst. Electr. Electron. Eng.).; 63: No. 1, 208(Jan 1975).

A multi-hetero-AlGaAs laser with an external waveguide to be used in the integrated optics was made. The laser action was achieved by an optical pumping, and the spectrum was narrower than that of the conventional double-hetero-AlGaAs lasers. (auth)

8780 ROTARY SPARK GAP SWITCHING FOR HIGH POWER DYE LASERS. Ferrar, C. M. (United Aircraft Research Labs., East Hartford, CT). Appl. Opt.; 13: No. 9, 1998-1999(Sep 1974).

A rotary spark gap is used in series with the flash lamp of a dye laser to give 150 pps. The dependence of laser output power on pulse repetition rate is given. (Elect. Electron. Abstr.)

8781 COHERENT OPTICAL PULSE RESHAPING IN A RESONANT MOLECULAR ABSORBER. Hamadani, S. M.; Goldhar, J.; Kurnit, N. A.; Javan, A. (Massachusetts Inst. of Tech., Cambridge). Appl. Phys. Lett.; 25: No. 3, 160-163(1 Aug 1974).

A resonant NH_3 absorber is employed for coherent reshaping of 2 to 40 ns N_2O laser pulses for a variable number of absorption lengths alpha l less than or equal to 14, and for small-area square pulses, subnanosecond pulses are produced at the leading and trailing edges. The results suggest that with the possibility of generating pulses of controllable shape and phase by using the transient response of an absorber, using a combination of absorbers and amplifiers with different bandwidths and saturation characteristics may prove helpful in obtaining certain required output pulses. (Elect. Electron. Abstr.)

8782 EFFECT OF DISSOLVED ATMOSPHERIC GASES UPON THE DECOMPOSITION OF CRYPTOCYANINE IN METHONAOLIC Q-SWITCH SOLUTIONS. Hollier, R. A.; Macomber, J. D. (Louisiana State Univ., Baton Rouge). J. Appl. Phys.; 45: No. 7, 2923-2925(Jul 1974).

As a study of the chemical stability of cryptocyanine dye molecules in dilute methanolic solution, it is found that removal of oxygen increases the stability on exposure to visible and uv radiation. Complete stability for such Q-switches was observed if they were completely degassed and containing them in cells which are both vacuum tight and opaque to uv. (Elect. Electron. Abstr.)

8783 QUENCHING OF LASER ACTION IN CRESYL VIOLET BY 6943 A RADIATION. Evans, D. E.; Purie, J.; Yeoman, M. L. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Appl. Phys. Lett.; 25: No. 3, 151-152(1 Aug 1974).

Complete quenching of laser action in the dye when pumped by the second harmonic of a ruby laser is achieved in the presence of light of wavelength 6943 A. It is believed that the quenching is due to depletion of the upper laser level population by stimulated emission, and further that the unsatisfactory performance of flash-pumped cresyl violet rhodamine 6G lasers may stem from the quenching action of a red component in the pump light. (Elec. Electron. Abstr.)

8784 CALORIMETER TO MEASURE THE 10.6-MU M ABSORPTION OF METAL SUBSTRATE MIRRORS. Saito, T. T.; Callender, A. B.; Simmons, L. B. (Kirtland AFB, NM). Appl. Opt.; 14: No. 3, 721-725(Mar 1975).

An instrument to calorimetrically measure the 10.6-mu m absorption alpha of high reflectivity metal-substrate mirrors has been designed, constructed, and tested. Optical, electrical, and thermal design considerations are discussed. The technique of absorption measurement, including the in situ heat capacities, the reflected laser light to an accuracy of +-4 percent, and the simplified data reduction technique are presented. From an error analysis it is concluded that the accuracy is +-0.1 alpha and has a precision of 0.0005. Comparative measurements on the same mirrors by different reflectivity and absorption devices and extensive absorption data on state-of-the-art 10.6-mu m metal-substrate mirrors are presented. The best absorption measured is 0.0010 for a gold-coated multidielectric enhanced mirror. (auth)

8785 OPTICAL PUMP SYSTEM FOR MODE-CONTROLLED LASER OPERATION. Leuenberger, H.U. (Lasag SA, CH-3600 Thun); Herziger, G. Appl. Opt. 14: No. 5, 1190-1192 (May 1975).

Generation of efficient mode-controlled emission with optically pumped laser systems requires a special resonator configuration in combination with an efficient pump system that homogeneously pumps the active medium. Several pump systems were investigated for their qualification. As a result an improved version of an elliptical cylinder system turned out to be favorable. Highly reproducible fundamental mode emission with a pulsed YAG laser system could be achieved. (auth)

8786 TEMPERATURE DEPENDENCE OF THE BAND GAP AND COMPARISON WITH THE THRESHOLD FREQUENCY OF PURE GaAs LASERS. Camassel, J. (Department of Physics, and Inorganic Materials Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Auvergne, D.; Mathieu, H. J. Appl. Phys. 46: No. 6, 2683-2689 (June 1975).

Recent measurements of the lasing energy as a function of temperature in high-purity GaAs lasers have attempted to investigate the relation between this energy and the one-electron band gap. Because of a lack of precision in the position of the band gap at high temperature, these measurements show strongly conflicting results. In this work, we report two sets of differential reflectivity measurements (electroreflectivity and piezoreflectivity) performed on GaAs under high-resolution conditions. Both series of results give for the excitonic absorption edge at room temperature a value $E_0 = 1.424 \pm 0.002$ eV which is about 20

meV higher than the lasing energy reported for the highest-purity GaAs samples. This result confirms that the lasing energy in GaAs is well below the one-electron band gap. In addition, we show that this energy separation is an increasing function of temperature. Finally we discuss a simple model of band-to-band recombination including electron-electron interaction effects and we show that it permits calculation of a temperature dependence of the lasing line in the range 80–300 °K which is in good agreement with the experiment. (auth)

8787 DYNAMIC COUPLING CHARACTERIZATION OF TEM_{00} Nd : YAG LASERS. Rice, R.R.; Teague, J.R.; Jackson, J.E. (McDonnell Douglas Astronautics Company-East, St. Louis, Missouri 63166). J. Appl. Phys. 46: No. 6, 2716-2720 (June 1975).

Experiments have been performed to test the simple linear and single transverse mode dynamic coupling models for a TEM_{00} Nd : YAG laser. An empirical power series model is presented and demonstrated. A novel intracavity variable output coupler useful for laser characterization is described. (auth)

8788 STRIPED GaAs LASERS: MODE SIZE AND EFFICIENCY. Hakki, B.W. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Appl. Phys. 46: No. 6, 2723-2730 (June 1975).

The stimulated efficiency of the fundamental mode and its beamwidth along the junction plane are calculated for GaAs double-heterostructure (DH) stripe-geometry lasers in a self-consistent analytical model. Carrier diffusion along the junction plane creates a gain profile which acts as the guiding mechanism for the propagating mode. The size of the mode and the diffusion-governed gain profile are the two interdependent parameters that enter into the characteristic equation whose solution determines the lasing threshold. The analytical results obtained indicate that the beamwidth is almost linearly related to the carrier diffusion length and stripe width. The minimum beamwidth obtainable for zero stripe width is $\simeq$1.3 times a diffusion length. The calculated waveguide loss, due to absorption in the unpumped region, increases with reduced stripe width. This mode loss is 5–7 cm^{-1} for 10–12-μm-wide stripes, in agreement with experiment. Due to the increased waveguide loss the predicted external efficiency decreases and the lasing threshold current density increases with decrease in stripe width. The increase in threshold is due not only to carrier loss by diffusion but also to the increase in absorption loss at reduced stripe width. (auth)

8789 IMPROVED CONVECTIVE FLOW LONGITUDINAL DISCHARGE CO LASER. Cohn, D.B.; Griffin, W.S.; Mendoza, P.J. (Northrop Research and Technology Center, 3401 West Broadway, Hawthorne, California 90250). J. Appl. Phys. 46: No. 6, 2790-2790 (June 1975).

Specific extraction efficiencies of 300 $W\,g^{-1}\,sec^{-1}$ have been obtained with flow-stabilized electrodes in a longitudinal electric discharge CO laser, representing a 50% enhancement over previous results. (auth)

8790 OPTICAL EFFICIENCY OF THE COAXIAL PUMPING SYSTEMS OF LIQUID LASERS. Zhuravleva, L. N.; Kromskii, G. I.; Shcherbakov, A. A. Zh. Prikl. Spektrosk.; 20: No. 6, 981-986(Jun 1974). (In Russian).

A theoretical study of the optical efficiency and the energy balance components of the coaxial pumping systems of liquid lasers is presented. The dependences of the optical efficiency of the systems on the absorption parameters of the active medium and the source plasma and on their geometric dimensions are analyzed. The resulting relationships make it possible to determine the values of the geometric and physical parameters of the pumping source and of the active body for practically important cases. These values determine the range of the effective operation of the pumping system. (JPRS)

8791 EFFICIENCY OF FAST-ELECTRON-BEAM EXCITATION OF MOLECULAR ELECTRONIC STATES OF HYDROGEN IN A HYDROGEN LASER. Knyazev, I.N. (Institute of Spectroscopy, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 10, 1197-1203 (Apr 1975).

An analysis is made of the efficiency of the excitation of molecular laser states in a vacuum ultraviolet by a beam of fast electrons. The efficiency is calculated for the whole laser cavity during one pulse. It is assumed that the electron energy is utilized optimally in a system in which the electrons are completely decelerated. Characteristics of specific collision processes are assumed and allowance is made for the secondary electrons of different generations. The total excitation efficiency of the laser states by the primary and secondary electrons is about 30%, and it approaches the limit for the quantum-mechanical system of a hydrogen laser (~50%). (auth)

8792 HOMOGENEOUS BROADENING AND NONLINEAR ABSORPTION IN A GAS RING LASER. Kuhlke, D.; Dietel, W. (Friedrich–Schiller Univ., Jena, Ger.). Phys. Lett.; 48A: No. 6, 441-442(29 Jul 1974).

The competition region of the oppositely directed waves of the gas ring laser are broadened by the homogeneous saturation and the nonlinear absorption. On certain conditions a pronounced peak appears in the range of the suppressed wave, which is caused by saturated absorption. (Elect. Electron. Abstr.)

8793 DISTRIBUTED-FEEDBACK SINGLE HETEROJUNCTION GaAs DIODE LASER. Scifres, D. R.; Burnham, R. D.; Streifer, W. (Xerox Palo Alto Research Center, CA). Appl. Phys. Lett.; 25: No. 4, 203-206(15 Aug 1974).

Laser operation of single-heterojunction GaAl As/GaAs diode lasers using a periodic structure within the gain medium of the device, thereby obviating the need for carefully cleaved end crystal faces to produce feedback, is reported. By varying the grating period, wavelengths from 8430 to 8560 A were observed. The threshold current densities were of the same order as for normal single-heterojunction diode lasers. Some advantages in output wavelengths were observed over lasers with cleared faces. (Elect. Electron. Abstr.)

8794 RESONATOR THEORY FOR HOLLOW WAVEGUIDE LASERS. Abrams, R. L.; Chester, A. N. (Hughes Research Labs., Malibu, CA). Appl. Opt.; 13: No. 9, 2117-2125(Sep 1974).

A numerical technique is described in detail for calculating the transverse modes and their losses for waveguide lasers with external mirrors. The Fresnel-Kirchhoff integral is used for propagation outside the guide but, within the guide, the fields are decomposed into the characteristic modes of the guide. Expressions for evaluation of the propagation matrix are given. (Elect. Electron. Abstr.)

8795 OPTICAL HOMOGENEITY OF A ULTRAVIOLET-PREIONIZED CO_2 LASER DISCHARGE. Clark, W. M. Jr. (Hughes Research Labs., Malibu, CA). Appl. Opt.; 13: No. 9, 1995-1997(Sep 1974).

The expanded beam of a Q-switched single mode ruby laser is used in a double exposure holographic interferometric arrangement to study the optical homogeneity of a discharge in a 1 : 1 : 8 mixture of CO_2, N_2, and He at 600 torr. An acoustical wave is seen to propagate from the cathode, but it is shown that for the first 4 to 7 mu sec, there is good optical quality in the central region of the laser medium. (Elect. Electron. Abstr.)

8796 INTENSITY FILTRATION OF LASER LIGHT. Thorne, J. M.; Loree, T. R.; McCall, G. H. (Los Alamos Scientific Lab., NM). J. Appl. Phys.; 45: No. 7, 3072-3078(Jul 1974).

Intensity filter systems have been developed which exploit the non-linear optical properties of CS_2 and bleachable dyes. The filters, primarily designed for use with mode locked Nd : YAG systems can however be used for longer pulses at any wavelength. The requirements are examined, and the configurations discussed for the following applications: (1) high or low intensity filters (2) positive or negative notch filters (3) isolators, and (4) pulse shapers. (Elect. Electron. Abstr.)

8797 IMPROVEMENT OF MIRROR SURFACES. Bennett, J. M. Nav. Res. Rev.; 27: No. 3, 29-35(Mar 1974).

Three instruments measuring the quality of mirrors used in high-energy laser applications are described: an optical instrument employing a Coblentz sphere for scattering and reflectance measurements at a whole series of laser wavelengths; a polarization-modulated ellipsometer; and an interferometric surface scanner. Factors reducing mirror reflectivity are discussed and the development of the bowl-feed polishing technique which leads to the reduction of surface irregularities is described. (Elect. Electron. Abstr.)

8798 SPECTROSCOPY AND MASS SPECTROSCOPY OF TEA CO_2 LASER DISCHARGE. Schotzau, H. J.; Adams, B.; Siegrist, M.; Kneubuhl, F. (Eidgenoessische Technische Hochschule, Zurich). Helv. Phys. Acta; 47: No. 1, 51-52(1974). (In German).

The output power of CO_2 laser sharply drops as the pulse frequency increases. The reason for this phenomenon is so far unknown. An investigation of CO_2 gas mixture by means of ir and mass spectroscopy was therefore initiated. A relationship between the chemical composition and the pulse frequency could be established with the use of simple experimental means. (Elect. Electron. Abstr.)

8799 DYNAMIC INSTABILITY OF SEMICONDUCTOR LASER AT LOW TEMPERATURES. Litvinov, V. F.; Molochev, V. I.; Morozov, V. I.; Nikitin, V. V.; Semenov, A. S. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 12, 747-750(20 Jun 1974). (In Russian).

The emission dynamics of a single mode injection semiconductor laser were studied at low temperatures. Experimental observations are made of the dynamic instability of the monochromatic emission mode, which is due to the coherent nature of the radiation-medium interaction in strong fields. (Elect. Electron. Abstr.)

8800 OPTICALLY PUMPED FAR-INFRARED AND MILLIMETER WAVE WAVEGUIDE LASERS. Tanaka, A.; Tanimoto, A.; Murata, N.; Yamanaka, M.; Yoshinaga, H. (Osaka Univ.). Jap. J. Appl. Phys.; 13: No. 9, 1491-1492(Sep 1974).

The authors describe the highly efficient waveguide laser in the FIR to millimeter wave region, and report a new laser transition at 1.217 mm. The pressure at maximum output power under a constant pump power in NH_3 gas pumped by an N_2O laser, and CH_3OH and CH_3CN gases pumped by a CO_2 laser are tabulated. (Elect. Electron. Abstr.)

8801 WAVEFORMS OF THE PULSE-EXCITED 647.1 nm Kr II LASER. Sakuma, E.; Tako, T. (National Research Lab. of Metrology, Tokyo). Jap. J. Appl. Phys.; 13: No. 9, 1489-1490(Sep 1974).

The excitation mechanisms for the pulse excited 647.1 nm Kr II line, one of the high power laser lines in the visible region are discussed. Generally, the output pulse has two peaks, the first one in rise time and the second in fall time of the current pulse. Observations indicate that the excitation in the high current region contributes much to the cascade excitation of the second peak; the second peak is mainly excited by the cascade excitation; and the time constant for the cascade transition is about 200 μs. (Elect. Electron. Abstr.)

8802 GAS DISCHARGE LASER OPERATING ON THE 1315 nm IODINE TRANSITION. Zalesskii, V. Yu. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 67: No. 1, 30-37(Jul 1974). (In Russian).

Arguments are presented which indicate the feasibility of a gas-discharge iodine laser based on the 1315 nm transition, the laser tube containing a mixture of oxygen and iodine vapor. Underlying operation of the laser is the experimental fact that transfer of electron excitation energy between iodine atoms and oxygen molecules occurs with a high efficiency. Construction of such a laser depends on how high the excitation temperature can be made by electron impact, the translational temperature of the atoms and molecules being kept at a sufficiently low level. Experiments are briefly described in which an increase of population of the metastable level I ($^2P_{\frac{1}{2}}$) due to oxygen is observed. (Elect. Electron. Abstr.)

8803 FREE OSCILLATING EMISSION INSTABILITY OF FAST FLOWING LASERS EMPLOYING UNSTABLE RESONATORS. Dreizin, Yu. A.; Dykhne, A. M. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 12, 718-722(20 Jun 1974).

The instability of stationary mode emission in a fast flowing laser with an unstable resonator was investigated. The radiation in the resonator is described in a geometrical optics approximation and the evolution of the active medium amplification factor is described by a model equation. The stationary emission mode is theoretically shown to be unstable. A pulsating emission mode (with a pulsation period of the order of the gas transit time through the resonator) emerges due to the collapse of the stationary emission. (Elect. Electron. Abstr.)

8804 CHEMICAL LASER TRIGGERED BY INFRARED RADIATION. Akinfiev, N. N.; Basov, N. G.; Galochkin, V. N.; Zavorotnyi, S. I.; Markin, E. P.; Graevskii, A. N.; Pankratov, A. V. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 12, 745-747(20 Jun 1974). (In Russian).

The results of investigations into the photochemical action of ir radiation are used as the basis for setting up experiments to achieve laser emission in a $SF_6 + H_2$ system. HF emission is achieved by using a pulsed CO_2 laser with an energy of 4 to 9 J. The energy of the HF laser is 10^{-3}J. (Elect. Electron. Abstr.)

8805 PULSED STIMULATED EMISSION DUE TO VIBRATIONAL TRANSITIONS IN THE CO MOLECULE IN MIXTURES WITH XENON. Anokhin, A. V.; Markova, S. V.; Petrash, G. G. Sov. J. Quant. Electron.; 4: No. 1, 51-54(Jul 1974).

Translated from Kvantovaya Elektron. (Moscow); 1: No. 1, 96-101(Jan 1974).

Stimulated emission deriving from vibrational transitions in the ground state of the CO molecule was investigated experimentally. It was found that the emission is particularly sensitive to the admixture of xenon to a CO-He mixture. The role of xenon in the establishing of populations in the vibrational levels of the CO molecule is analyzed. (Elect. Electron. Abstr.)

8806 TEMPERATURE FIELD IN THE CO LASER. Leshenyuk, N. S.; Orlov, L. N. (Inst. of Physics, Minsk). Sov. Phys. - Tech. Phys.; 18: No. 11, 1504-1507(May 1974).

Translated from Zh. Tekh. Fiz.; 43: No. 11, 2382-2387(Nov 1973).

The temperature field of the working mixture for electrically excited CO laser systems with gas flow is calculated. The effects of gas velocity and the temperature and geometry of the walls are included. (Elect. Electron. Abstr.)

8807 SPECTRA OF FORMATION OF COLOR CENTERS IN LASER GLASSES. Glebov, L. B.; Tolstoi, M. N. Sov. J. Quant. Electron.; 4: No. 1, 65-67(Jul 1974).

Translated from Kvantovaya Elektron.; 1: No. 1, 119-123(Jan 1974).

The spectra of formation of color centers in silicate laser glasses were studied. The position of the spectral peak, observed in the wavelength range 180 to 240 nm is highly correlated with the position of the absorption edge of the glass. The formation of color centers can be prevented by excluding radiation in the 180 to 240 nm range from the exciting light, which is the reason for the effectiveness of Ce or Ti antisolarizers. (Elect. Electron. Abstr.)

8808 ACTIVELY MODE-LOCKED TEA CO_2 LASER WITH MULTILINE OUTPUT. Sakane, T. (Electro-Technical Lab., Tokyo). Opt. Commun.; 12: No. 1, 21-23(Sep 1974).

An actively mode-locked TEA CO_2 laser producing pulses consisting of more than 3 lines of the 10.4 μm band by inserting a KCl plate is described. (Elect. Electron. Abstr.)

8809 SATURABLE ABSORBER MODE-LOCKING AND LASER PULSE COMPRESSION. Lim, T. K.; Garside, B. K. (McMaster Univ., Hamilton, Ont.). Opt. Commun.; 12: No. 1, 8-13(Sep 1974).

The theoretical predictions of two alternative models of saturable absorber mode-locking in dye lasers are compared. The predicted mode-locking and pulse compression regimes are considered for both flashlamp-pumped and cw dye lasers, and some questions raised thereby are tested by numerical simulation of pulse propagation. (Elect. Electron. Abstr.)

8810 FREQUENCY LOCKING OF A SOLID-STATE LASER, WITH EXTERNALLY-CONTROLLED UNEVENLY-BROADENED SPECTRAL GAIN LINES IN A FREE-OSCILLATORY MODE. Bocharov, V. V.; Zubarev, I. G. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 7, 964-969(1974). (In Russian).

The frequency locking of a solid-state Nd-glass laser by an external force is realized. The locking band in a practical system is shown to be $\lesssim 10\ cm^{-1}$. The energy gain $> 10^2$ is experimentally obtained when the spectrum is narrowed by more than 10^3 times. (Elect. Electron. Abstr.)

8811 cw FIBER LASER OF NdLa PENTAPHOSPHATE. Weber, H.P.; Liao, P.F.; Tofield, B.C.; Bridenbaugh, P.M. (Bell Telephone Laboratories, Holmdel, New Jersey 07733). Appl. Phys. Lett. 26: No. 12, 692-694 (15 June 1975).

cw operation at 1.051 μm of a waveguide laser consisting of a crystalline fiber of $Nd_{0.5}La_{0.5}P_5O_{14}$, 12×12 μm in cross section and 0.68 mm in length, is reported. When longitudinally pumped with a Kr ion laser at 752.5 nm the room-temperature laser threshold was less than 10-mW absorbed power. (auth)

8812 PROPOSED METHOD FOR OBTAINING POPULATION INVERSION FOR VACUUM-ULTRAVIOLET AND X—RAY TRANSITIONS. Norton, B.A.; Wooding, E.R. (Department of Physics, Royal Holloway College, Egham Hill, Egham, Surrey TW20 0EX, England). Phys. Rev. A 11: No. 5, 1689-1691 (May 1975).

A method for producing population inversion in a plasma for use as an x-ray or vacuum-ultraviolet lasing medium is described. The process involves a method for removal of the lower quantum levels of an ion, based upon their velocity, which results in an inversion between them and various upper levels. A possible device and its operating characteristics are also discussed. (auth)

8813 APODISED APERTURE ASSEMBLY FOR HIGH POWER LASERS. Bliss, E. S.; Speck, D. R. (to U. S. Atomic Energy Commission). US Patent 3,867,017. G02b9/00; G02b9/08. 18 Feb 1975. Filed date 27 Nov 1973. 4p.

PAT-APPL-419,315.

An apodized aperture assembly using absorbing liquid or solid to vary transmission over the cross section thereof is used to minimize deleterious diffraction effects in high power lasers. By employing, for example, an absorbing liquid of varying optical density to obtain the transmission profile, a circular aperture of this type can be used to minimize diffraction effects, thereby substantially improving the performance of a high power laser system. (auth)

8814 FLASHLAMP-PUMPED DYE LASERS WITH TUNABLE WAVELENGTH. Schmidt, W.; Wittekindt, N. Zeiss Inf.; 20: No. 80, 33-35(Dec 1973).

Sufficient laser dyes are now known to produce laser-emission at virtually any desired wavelength between 340 and 1200 nm. The laser process in dye solutions is discussed. Flash tubes produce high power pulses of less than 1 μsec duration which now replace the use of short light pulse pumping from other high performance lasers. (Elect. Electron. Abstr.)

8815 RESOLUTION OF A LASER BEAM. Kratirov, I. A.; Pavlov, V. M. Tekh. Kino Telev.; No. 4, 63-67(Apr 1974). (In Russian).

The resolution of the scanning beam from a laser with a spherical resonator is evaluated. Experimental data is given. (Elect. Electron. Abstr.)

8816 APPLICATION OF LOW TEMPERATURES IN INDUSTRIAL FABRICATION. Golke, H. (Messer Griesheim G.m.b.H.,

Duesseldorf (F. R. Germany). Abt. Industriegase). Tech. Mitt.; 67: No. 12, 572-576(Dec 1974). (In German).

The author shows the advantages of this method and describes some industrial processes successfully using very low temperatures. (GE)

8817 INSTANT RECORDING OF THE DURATION OF A SINGLE MODE-LOCKED Nd:YAG LASER PULSE. Lompre, L. A.; Mainfray, G.; Thebault, J. (CEN de Saclay, Gif-sur-Yvette, France). Appl. Phys. Lett.; 26: No. 9, 501-503(May 1975).

An electro-optic streak camera incorporating a storage memory video system has been developed and used to instantly visualize and record the shape of a 1.06-mu-wavelength pulse generated by a mode-locked Nd:YAG laser. The duration of a single laser pulse (approximately 30 psec) has been directly measured with and without laser amplification. (auth)

8818 TWO-PHOTON STIMULATED EMISSION AND PULSE AMPLIFICATION. Yuen, H. P. (Massachusetts Inst. of Tech., Cambridge). Appl. Phys. Lett.; 26: No. 9, 505-507(1 May 1975).

Threshold conditions are given for the sustained operation of standing-wave and long-pulse traveling-wave two-photon lasers. Pulse shortening in long-pulse two-photon amplification, a behavior absent in the one-photon case, is also demonstrated analytically. (auth)

8819 OBSERVATIONS OF SMALL-SIGNAL GAIN IN HIGH-PRESSURE PULSED CO ELECTRIC DISCHARGE LASER. Boness, M. J. W.; Center, R. E. (Avco Everett Research Lab., Inc., MA). Appl. Phys. Lett.; 26: No. 9, 511-514(1 May 1975).

Measurements are reported of the magnitude and temporal behavior of small-signal gain in a pulsed high-pressure carbon monoxide electric discharge laser. These are compared with predictions derived from kinetic modeling calculations. Maximum gain of 4.5 percent/cm was measured on the 9P(10) and 8P(10) transitions. The measurements and calculations support the hypothesis that resonance absorption by overlapping transitions is the mechanism responsible for gain suppression on certain lines. (auth)

8820 DOUBLE-HETEROSTRUCTURE GaAs DISTRIBUTED-FEEDBACK LASER. Shank, C. V.; Schmidt, R. V.; Miller, B. I. (Bell Telephone Lab., Holmdel, NJ). Appl. Phys. Lett.; 25: No. 4, 200-201(15 Aug 1974).

The fine optical corrugations (approximately 1150A) are etched into the GaAs-GaAlAs heterostructure and regrown into the interface between the two layers of the heterostructure. With optical pumping laser operation has been observed both before and after the growth of the final layer. The operation of the device suggests a way of making a distributed feedback injection laser. (Elect. Electron. Abstr.)

8821 APPLICATION OF PRESSURE SCANNING TO THE TUNING OF A HIGH RESOLUTION DYE LASER. Flach, R.; Shahin, I. S.; Yen, W. M. (Univ. of Wisconsin, Madison). Appl. Opt.; 13: No. 9, 2095-2099(Sep 1974).

Pressure tuning of a dye laser pumped by a nitrogen laser is described. Tuning is by a grating with an intracavity etalon or by grating, etalon and extracavity confocal filter. Pressure chambers of dry nitrogen surround the grating filter combination and the filter, respectively. Without the filter, the tuning range is more than 40 cm^{-1}. With the filter the scan range is 4 cm^{-1}. Results of an absorption experiment show isotope shifts of the chromium ions in ruby. (Elect. Electron. Abstr.)

8822 NATURE OF OPTICALLY INDUCED DEFECTS IN Ga/sub 1-x/Al/sub x/As–GaAs DOUBLE-HETEROJUNCTION LASER STRUCTURES. Petroff, D.; Johnston, W. D. Jr.; Hartman, R. L. (Bell Labs., Murray Hill, NJ). Appl. Phys. Lett.; 25: No. 4, 226-228(15 Aug 1974).

Transmission electron microscopy techniques show that the dark line defect (DLD) structure which arises from the optical pumping of undoped double-heterostructure laser material Ga /sub 1-x/Al/sub x/As–GaAs is similar to that which develops in simple p-n junction laser diode material. This suggests that the DLD development and failure of cw lasers is related to the material and not necessarily to p-n junction doping materials or to the technology of the metal contacts. (Elect. Electron. Abstr.)

8823 EFFECTS OF FOREIGN GASES ON THE PULSED OPERATION OF A CO_2 LASER. Kitazima, I. (Fukui Univ., Japan). J. Appl. Phys.; 45: No. 7, 2997-3004(Jul 1974).

A study has been made of the influence of foreign gases such as He, N_2, and Xe on the pulsed output from a 10.6 mu m CO_2 laser. The effects on the time behavior of both laser pulses and current pulses are reported in a pulsed discharge operation with a current pulse width of 7 msec. The ways in which the pumping and relaxation mechanisms are affected by the gas additives are also discussed. (Elect. Electron. Abstr.)

8824 CAVITY-DUMPED ARGON-ION LASER AS AN EXCITATION SOURCE IN TIME-RESOLVED FLUORIMETRY. Lytle, F. E.; Kelsey, M. S. (Purdue Univ., Lafayette, IN). Anal. Chem.; 46: No. 7, 855-860(Jun 1974).

Both the operational principles and the experimental aspects of cavity-dumping the continuous wave (CW) argon-ion laser are discussed. The technique is used to construct an excitation source for time-resolved fluorimetry having the advantages of a variable repetition rate (approximately 10 MHz to single-shot), variable pulse width (approximately 9 nsec to CW) and moderate peak power per unit band width (approximately 12W in the blue-green and 600 mW in the uv). Two classes of sample data are shown for molecules at trace (ppb) levels. Finally, future instrumental advances are discussed that should allow much shorter pulse widths and greater wavelength selection. (Elect. Electron. Abstr.)

8825 ABSOLUTE-PHOTOMETRY DETERMINATION OF THE RATE CONSTANT OF THE GAS-PHASE REACTION OF THE RADICAL COMPOUND C_3F_7 AND $I(^2P_{3/2})$. Skorobogatov, G.A.; Komarov, V.S.; Seleznev, V.G. (A. A. Zhdanov Leningrad State University). Sov. Phys.—Tech. Phys. 19: No. 9, 1239-1241 (Mar 1975).

A method described elsewhere has been used to measure the differential quantum yield of the stimulated emission of a C_3F_7I laser at peak output: (140±20) % and (148±12) % for initial perfluorinated propyl iodide pressures of 22.3 and 74.2 torr, respectively. Calculations based on these quantum yields yield a rate constant of k_{11} (360°K)=(1.5±0.5) $\cdot 10^{-10}$ cm^3/(molecule·sec) for the gas-phase reaction $C_3F_7 + I(^2P_{3/2}) \rightarrow C_3F_7I$. (auth)

8826 SOLID-STATE LASER WITH EXTERNALLY FORCED *Q* SWITCHING. Galaktionova, N.M.; Mak, A.A.; Khyuppenen, A.P. Sov. Phys.—Tech. Phys. 19: No. 9, 1174-1176 (Mar 1975).

An experimental investigation of the modulation of the radiation of a stabilized YAG : Nd^{3+} laser is reported; the resonator loss is modulated over a wide range of frequencies and modulation indices. By varying the loss modulation of a single-mode laser all the usual operating conditions of solid state lasers can be obtained. The modulation indices are measured. The results are in good agreement with the solutions of the linearized kinetic equation over a wide range of modulation. The mechanisms by which the resonator loss is modulated is discussed. (auth)

8827 OPERATION OF AN EXTERNALLY LOCKED RING LASER. Milovskii, N.D.; Yastrebova, T.V. (N. I. Lobachevskii Gor'kii State University). Sov. J. Quantum Electron. 4: No. 11, 1295-1298 (May 1975).

A theoretical analysis is given of the influence of a resonance signal on the stability of a single-frequency traveling-wave laser. A one-dimensional model of a ring laser is used. It is assumed that the active medium of this laser has a homogeneously broadened luminescence line. The losses in the laser resonator are concentrated. It is also assumed that the external signal frequency coincides with the emission frequency and they are both equal to the central frequency of the luminescence line. It is shown that the critical value of the excess of the pump power over the threshold at which the single-frequency emission becomes unstable increases with rising intensity of the external signal but always remains finite. (auth)

8828 INVESTIGATION OF A CO_2 PULSED LASER EMITTING AT $\lambda = 10.6\ \mu$ AND PUMPED BY $\lambda = 9.6\ \mu$ CO_2–N_2–He LASER RADIATION. Balykin, V.I.; Golger, A.L.; Kolomiiskii, Yu.R.; Letokhov, V.S.; Tumanov, O.A. (Akademgorodok Institute of Spectroscopy, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 11, 1325-1331 (May 1975).

An experimental and theoretical investigation was made of the amplification and stimulated generation of $\lambda = 10.6\ \mu$ radiation (00^01–10^00 transition) in CO_2 pumped with a pulsed CO_2 laser emitting at $\lambda = 9.6\ \mu$ (00^00–02^00 transition). A study was made of the dependence of the gain on the pumped energy density for various values of pressure and temperature. The room-temperature gain at pressures up to 1 atm was 4×10^{-4} cm^{-1}. The maximum value of the gain (2×10^{-3} cm^{-1}) corresponded to $p = 100$ mm Hg and $T = 400$ °K. The results obtained were in good agreement with the theory. The emission of 10.6 μ radiation as a result of $\lambda = 9.6\ \mu$ optical pumping was achieved and investigated for the first time in a wide range of CO_2 pressures and temperatures of 80–600 mm Hg and 330–400 °K. (auth)

8829 PARAMETERS OF AN ELECTRON-BEAM-PUMPED DOUBLE-DOPED GALLIUM ARSENIDE LASER. Borisov, N.A.; Lavrushin, B.M.; Lebedeva, L.V.; Strel'chenko, S.S. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 11, 1332-1336 (May 1975).

An investigation was made of the laser action in compensated gallium arsenide doped with donors (Te or Sn) and acceptors (Zn). Such doping reduced considerably the threshold current density and the working voltage of electron-beam-pumped lasers. The lowest values of the

threshold were 0.1 A/cm² at $T \simeq 85$ °K and 1.5 A/cm² at $T \simeq 300$ °K. The maximum efficiency reached 30% at $T \simeq 85$ °K and 21% at $T \simeq 300$ °K. A waveguide resonator structure ensured that these values of the threshold current and the efficiency were not affected when the electron energy was reduced from 50 keV to ~25 keV. A further reduction of the electron energy to 9 keV caused the threshold current density to rise to 1.5 A/cm² at $T \simeq 85$ °K. (auth)

8830 FAST-RESPONSE METER FOR MEASURING THE POWER OF CARBON DIOXIDE LASER RADIATION. Kuz'michev, V.M.; Perepechai, M.P. (A. M. Gor'kii Khar'kov State University). Sov. J. Quantum Electron. 4: No. 11, 1337-1339 (May 1975).

A theory is given of the operation of a detector element suitable for measuring the power of transmitted CO_2 laser radiation. The experimental results of a study of this element are also reported. The element consists of a double array of thin-wire (3.8 μ diameter) bolometers. When this detector is coupled to a suitable circuit, we can use it to measure power densities beginning from 5 W/cm² with an error of ±13%. The response time is 1 msec and the transmission coefficient of the detector exceeds 98%. (auth)

8831 STABILIZATION OF THE EMISSION FREQUENCY OF A CO_2 LASER TO WITHIN 10^{-12} WITH THE AID OF NARROW SF_6 AND OsO_4 RESONANCES. Gusev, V.M.; Kompanets, O.N.; Kukudzhanov, A.R.; Letokhov, V.S.; Mikhailov, E.L. (Akademgorodok Institute of Spectroscopy, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 11, 1370-1372 (May 1975).

A long-term stability better than 10^{-12} (averaging time 100 sec) was achieved for the emission frequency of a cw CO_2 laser, which was stabilized using narrow saturated-absorption resonances in an external low-pressure SF_6 cell. Narrow molecular resonances of OsO_4 were used as a second natural frequency standard. A nonlinear spectrometer with a stabilized CO_2 laser and an external OsO_4 absorption cell was found to be suitable for measurement of the energy of metastable osmium nuclei. (auth)

8832 EXPERIMENTAL INVESTIGATION OF THE AMPLIFICATION OF LIGHT AND OF COHERENT EMISSION FROM A $N_2O+CO+He$ MIXTURE EXPANDING IN A SUPERSONIC NOZZLE. Testov, V.G.; Grin', Yu.I.; Piskunov, A.K. (Institute of Radio Engineering and Electronics, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 11, 1378-1379 (May 1975).

An experimental investigation was made of the amplification of light and of coherent emission from a 10% $N_2O+20\%$ $CO+70\%$ He gas mixture. The amplification was recorded at $\lambda = 10.6$ and 10.9 μ at a distance of 15 mm from the nozzle edge. The maximum amplification was obtained when the velocity of the incident shock wave was ~1.9 km/sec, which corresponded to a deceleration temperature $T_0 \sim 2100$ °K. In the presence of mirrors the mixture emitted coherent $\lambda = 10.6$ μ radiation under maximum-gain conditions. (auth)

8833 TUNABLE (720–970 nm) LASER WITH A SINGLE-STAGE ORGANIC-DYE AMPLIFIER. Bonch-Bruevich, A.M.; Razumova, T.K.; Starobogatov, I.O. Sov. J. Quantum Electron. 4: No. 11, 1380-1382 (May 1975).

A tunable ($\lambda = 720$–970 nm) laser system utilizing organic dye solutions was built and investigated. The system comprised an oscillator with a dispersive resonator (diffraction grating), a prism telescope, and a single-pass power amplifier using the same dye solutions. The system was excited with a Q-switched ruby laser. When the excitation power was divided in the ratio 1:4 between the oscillator and amplifier, the gain of the system as a whole was 25. The width of the output spectrum was 1–4 Å. The radiation was emitted in the form of 0.25 J pulses of 20 nsec duration. The radiation power density reaching the grating was 0.6 MW/cm². The construction of the system should make it possible to increase the angular brightness of the radiation and to reduce the modulation of the spectral-energy tuning characteristic. (auth)

8834 INFLUENCE OF THE SHAPE OF A DISCHARGE-GAP CROSS SECTION ON THE GAS-LASER GAIN. Privalov, V.E.; Yudin, S.F. (M. I. Kalinin Leningrad Polytechnic Institute). Sov. J. Quantum Electron. 4: No. 11, 1383-1384 (May 1975).

A geometric contribution to the active-medium gain is estimated for laser tubes of circular, rectangular, and elliptic cross sections. The gain averaged over an elliptic cross section is found to decrease with increasing ellipse eccentricity and this gain is intermediate between those obtained for circular and rectangular cross sections (the gain on the axis is assumed to be the same in all cases). A smoother distribution of the gain over elliptic and rectangular cross sections and lower diffraction losses suggest that tubes with these cross sections should be used in ring lasers. (auth)

8835 AMPLIFICATION OF YAG:Nd LASER RADIATION IN NEODYMIUM GLASS AND GENERATION OF HIGH-POWER FOURTH HARMONIC. Abakumov, G.A.; Antipov, A.I.; Lyashenko, A.I.; Simonov, A.P.; Fadeev, V.V.; Kharitonov, L.A.; Shvom, E.M. (M. V. Lomonosov Moscow State University). Sov. J. Quantum Electron. 4: No. 11, 1385-1385 (May 1975).

An experimental study was made of the amplification of YAG:Nd laser radiation in neodymium glass (gain $k = 50$) and of subsequent conversion of this radiation into a stable fourth harmonic of 6.5 ± 1.5 MW power. (auth)

8836 INVESTIGATION OF AN ELECTRIC-DISCHARGE N_2O LASER. Demin, A.I.; Kudryavtsev, E.M.; Kulagin, Yu. A.; Sobolev, N.N. (P.N. Lebedev Physics Institute, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 11, 1393-1395 (May 1975).

A description is given of the construction of a continuously pumped electric-discharge laser using a N_2O–He–N_2 mixture. The optimal ratio of the components in the mixture was 1:4:2 for a constant flow velocity of 4 m/sec; this corresponded to an output power of 0.5 W. We studied the influence of xenon on the operation of this laser. A diffraction grating was used as a selective element to achieve stimulated emission of several rotational lines of the P and R branches of the 00^01–10^00 transition of the N_2O molecule in the wavelength range 10.4–11.0 μ. (auth)

8837 MULTICIRCUIT HIGH-VOLTAGE PULSE GENERATOR. Nasibov, A.S.; Svinenkov, A.I. (P.N. Lebedev Physics Institute, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 11, 1398-1399 (May 1975).

A description is given of several variants of a high-voltage pulse generator based on LC circuits. This generator can supply several loads simultaneously. The construction of a generator capable of producing pulses up to 200 kV is described. Such a generator can be used as a power source of high-current accelerators and for pumping various semiconductor and gas lasers. (auth)

8838 GENERATION OF ULTRAVIOLET RADIATION TUNABLE IN THE 216–226 NM RANGE. Abakumov, G.A.; Buzgenda, Kh.; Dorsenvil', R.; Medvedeva, A.M.; Sebekina, N.N.; Simonov, A.P.; Fadeev, V.V. (M. V. Lomonosov Moscow State University). Sov. J. Quantum Electron. 4: No. 11, 1404-1405 (May 1975).

An analysis is made of one of the possibilities of generating tunable radiation in the wavelength range $\lambda = 200$–260 nm. The results are given of an experimental investigation in which such radiation was generated in the 216–226 nm range. (auth)

8839 Q-SWITCHED NEODYMIUM-GLASS LASER GENERATING SHORT PULSES. Davydov, B.A.; Muratov, V.R.; Soms, L.N.; Stepanov, A.I.; Stupnikov, V.K. Sov. J. Quantum Electron. 4: No. 11, 1406-1407 (May 1975).

An investigation was made of the characteristics of a Q-switched laser utilizing a phosphate glass and producing pulses with a repetition frequency up to 5 sec^{-1}. The pulse duration was 15 nsec when the Q factor of the resonator was switched by an optomechanical modulator with a prism rotating at an equivalent angular velocity of 60,000 rpm. (auth)

8840 ELECTRON-BEAM-CONTROLLED CARBON MONOXIDE LASER WITH AN OUTPUT ENERGY UP TO 100 J. Basov, N.G.; Danilychev, V.A.; Ionin, A.A.; Kovsh, I.B.; Sobolev, V.A. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 11, 1412-1413 (May 1975).

An investigation was made of the operation of a pulsed electron-beam-controlled CO laser with a working mixture kept at room temperature. It was found possible to build a large (10 liter) laser of this type. When the excitation duration was ~30 μsec, the output energy exceeded 100 J per pulse. (auth)

8841 MAXIMUM OUTPUT ENERGY OF AN ELECTRON-BEAM-CONTROLLED CO_2 LASER. Basov, N.G.; Danilychev, V.A.; Ionin, A.A.; Kovsh, I.B.; Sobolev, V.A.; Suchkov, A.F.; Urin, B.M. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 11, 1414-1415 (May 1975).

An experimental and theoretical investigation was made of an electron-beam-controlled CO_2 laser operating under conditions ensuring the maximum output energy. This energy exceeded 1000 J per pulse. Overheating of the active mixture and the development of electric discharges in the active region at high pump powers limited the specific output energy to 75–80 $J \cdot liter^{-1} \cdot atm^{-1}$. (auth)

8842 TABLE-TOP Ar-N_2 LASER. Ault, E.R. (Northrop Research and Technology Center, Hawthorne, California 90250). Appl. Phys. Lett. 26: No. 11, 619-620 (1 June 1975).

A compact $Ar-N_2$ excitation transfer laser pumped by a coaxial electron gun is demonstrated. This laser emits a 40-ns, 300-kW pulse at a nominal repetition rate of 1 HZ. With 45 J of energy delivered to the electron gun, 12 mJ of laser output at 3577 Å is obtained. A 2.8% laser efficiency is estimated from simple electron deposition calculations, and the over-all electrical efficiency is estimated to be 0.03%. Because the stored energy needed in previously reported $Ar-N_2$ lasers has been reduced by more than an order of magnitude while maintaining a comparable laser energy output, this device represents a significant step forward in the study of high-pressure electron-beam-pumped lasers. (auth)

8843 FAR-INFRARED SUPERRADIANT LASER ACTION IN METHYL FLUORIDE. Evans, D.E.; Sharp, L.E. (EURATOM-UKAEA Association for Fusion Research, Culham Laboratory, Abingdon, Oxon OX14 3DB, United Kingdom); James, B.W.; Peebles, W.A. Appl. Phys. Lett. 26: No. 11, 630-632 (1 June 1975).

Submillimeter laser pulses exceeding 1-MW power have been generated superradiantly in CH_3F gas pumped by 200 MW of 9.55-μ CO_2 TEA laser radiation. When far-infrared output was restricted to operation on the 496 line alone, 0.5 MW was achieved within a bandwidth of 100 MHz. (auth)

8844 LOW-DIVERGENCE BEAMS FROM GRATING-COUPLED COMPOSITE GUIDE HETEROSTRUCTURE GaAlAs DIODE LASERS. Burnham, R.D.; Scifres, D.R.; Streifer, W. (Xerox Palo Alto Research Center, Palo Alto, California 94304). Appl. Phys. Lett. 26: No. 11, 644-647 (1 June 1975).

Room-temperature operation of a new grating-coupled heterostructure diode laser is reported. The laser contains two GaAs layers separated by a GaAlAs layer. One of the GaAs layers is electrically pumped, whereas the other is corrugated. Light is distributed over both layers and the grating couples out low-divergence polarized beams approximately normal to the p-n junction. Room-temperature thresholds as low as 2 kA/cm^2 have been observed. (auth)

8845 ASTIGMATISM-AND COMA-FREE PRISM DYE RING LASER. Marowsky, G. (Max-Planck-Institut für Biophysikalische Chemie, Göttingen, Germany). Appl. Phys. Lett. 26: No. 11, 647-649 (1 June 1975).

The characteristics of two prism ring lasers for cw operation have been experimentally studied. With improved compensation for aberrations due to astigmatism and coma, cw ring lasers operated in the traveling-wave mode provide high output efficiency, stable narrow bandwidth in multimode and single-mode operation, and a broad tuning range. (auth)

8846 LOW-THRESHOLD CW $LiNdP_4O_{12}$ LASER. Chinn, S.R.; Hong, H.Y. (Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Massachusetts 02173). Appl. Phys. Lett. 26: No. 11, 649-651 (1 June 1975).

We have studied cw room-temperature lasing behavior of $LiNdP_4O_{12}$. A threshold of 360-μW optical excitation power at 0.582 μm wavelength was measured, with 18% power conversion efficiency to 1.048-μm radiation at 1-mW output. The crystal structure is found to be monoclinic ($C2/c$) rather than orthorhombic as previously reported. (auth)

8847 EFFECT OF DEUTERIUM ON THE OPERATION OF A CO_2 TEA LASER. Albrecht, H.; Bespalov, V.A.; Platonenko, V.T. (Moscow State University). JETP Lett. 21: No. 1, 34-35 (5 Jan 1975).

We describe experiments that show that addition of deuterium greatly improves the characteristics of the working mixtures in a CO_2 laser. In the case of mixtures containing nitrogen, addition of deuterium has made it possible to increase the output laser energy by 22%. In the case of mixtures that contain no nitrogen, replacement of the helium by deuterium leads to an increase of the output energy by 3–4 times with a negligible change in the pulse duration. (auth)

8848 REDUCTION OF COMPETITION WITH INCREASING NUMBER OF MODES IN A GAS LASER. Zeiger, S.G.; Pelyukhova, E.B. Opt. Spectrosc. (USSR) 38: No. 1, 74-77 (Jan 1975).

Mode interaction at close frequencies with any pump is studied when the central mode is stable against the formation of the first pair of symmetrically situated side modes. The next pair of longitudinal modes appears with increasing pump so that the lasing spectrum is diluted by a factor of two compared to the resonator spectrum. It is then found that with the appearance of the next pair of modes the gain of the omitted modes increase so that they also appear in lasing, i.e., all the resonator frequencies (and not every other one) will be in the lasing spectrum. Complete self-locking of the beat frequencies of the generated modes with the lasing modes leading to amplification of the stimulated radiation, is the cause of the reduction of competition. (auth)

8849 LASING REGIMES IN AN ARGON ION LASER WITH A NONLINEAR ABSORBER. Borisova, M.S. Opt. Spectrosc. (USSR) 38: No. 1, 80-82 (Jan 1975).

Various lasing regimes of an argon ion laser with a nonlinear absorber lasing in the 4880-Å range are studied. The regimes were varied by varying the discharge currents of the amplifier and the absorber. It is shown that both complete and partial self-mode-locking are realized in the argon laser. (auth)

8850 LASING PROPERTIES OF MIXTURES OF RHODAMINE SOLUTIONS. Levin, M.B.; Cherkasov, A.S.; Shirokov, V.I. Opt. Spectrosc. (USSR) 38: No. 1, 83-84 (Jan 1975).

The effect of the relative composition of mixtures of rhodamine-dye solutions on the lasing energy E_l with lamp excitation is studied. It is shown that the addition of unsubstituted rhodamine in rhodamine 6G (R6G) solution increases E_l at R6G concentrations less than 5×10^{-5} mol. The addition of R6G to rhodamine C solutions is more effective to a relative degree without constraints on the concentrations of components. The difference in the results is due to different mechanisms for the participation of mixture components in lasing. (auth)

8851 SPIN-FLIP RAMAN LASER. Weiler, M. H.; Aggarwal, R. L.; Lax, B. (Massachusetts Inst. of Tech., Cambridge). pp 221-239 of Application of High Magnetic Fields in Semiconductor Physics. Wurzburg, Ger.; Univ. Wurzburg (1974).

The history of stimulated spin-flip Raman scattering is reviewed, both theoretical treatments and experiments in various materials. Recent theoretical and experimental progress is discussed for the InSb spin-flip Raman laser. Present and future applications are described. (Elec. Electron. Abstr.)

8852 PICOSECOND LASER PULSE GENERATOR. Carlson, D. G. IBM Tech. Disclosure Bull.; 16: No. 10, 3455-3456(Mar 1974).

A system for generating picosecond optical pulses that does not require the use of a mode-locked laser is presented. (Elect. Electron. Abstr.)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 9395, 9448, 9639, and 9656.

8853 (AD-786156) CRYOGENIC SYSTEMS AND SUPER-CONDUCTIVE POWER. Final Technical Report, 1 October 1973–16 July 1974 on Phase 3. Hatch, B. D.; Hurley, J. D.; Jones, D. W.; Laskaris, E. T. (General Electric Co., Schenectady, N. Y. (USA)). 16 Jul 1974. Contract DAHC15-72-C-0235. 90p. (GE-SRD-74-080). NTIS $4.75.

Extreme environments are a common requirement of military applications of propulsion machinery, so that superconductive propulsion systems for ships and military vehicles must be of rugged and highly reliable construction. For this reason, emphasis was given to shock and vibration testing of representative superconductive coils during operation in a superconducting mode near the upper current density limit. Supplementary tests were also made to determine structural and mechanical properties of materials used in composite material superconducting coils operated at liquid helium temperatures. The second area of experimental evaluation involved liquid metal collectors for acyclic superconductive machines in which gallium is used as the liquid metal. (auth)

8854 (BNL-19962) PERFORMANCE OF Nb_3Sn MULTIFILAMENTARY SUPERCONDUCTORS IN SOLENOIDAL MAGNETS. Sampson, W. B.; Suenaga, M.; Robins, K. E. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 5p. (CONF-750444-2). Dep. NTIS $4.00.

From conference on magnet technology; Frascati, Italy (21 Apr 1975).

High current Nb_3Sn multifilamentary conductors have been formed by heat treating cables braided from three types of composite wire. In the simplest configuration, these wires contain niobium filaments in a pure copper matrix. After braiding the conductor is coated with a layer of tin which diffuses through the copper during heat treatment to form Nb_3Sn filaments. The second configuration is made from wires containing niobium filaments in a copper-tin alloy and requires only heat treatment to form the Nb_3Sn filaments. The third type of braid has wires which consist of groups of niobium filaments in the bronze matrix which are in turn in a copper matrix. Tantalum barriers surround each group of filaments to prevent the tin from contaminating the pure copper matrix. The cables have been wound into solenoids after heat treatment and the effect of mechanical handling was studied by monitoring the resistive voltage distribution in the coils. (auth)

8855 (IPP-4/128) EXPERIMENTAL RESULTS WITH SL/NL BREAKERS. Amenda, W.; Pillsticker, M.; Soell, M. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jan 1975. 51p. (In German). Dep. NTIS (US Sales Only) $5.75.

The switching-off effect of a superconductive/normal conductive (SC/NC)-breaker (cryotron) is based on the increase of the resistance from 0 to a determined value, if the transition from the superconductive to the normal conductive state is triggered. Thus, the very high current density in the superconductive phase can be utilized. The fast commutation of a current from one branch of a network to another can be started by the switching-off effect of a SC/NC-breaker. Results of several tests with SC/NC-breakers suitable for high currents up to 800 A are reported. The trigger methods used are: (1) heating of the switch-material up to $T > T_c$ and (2) increase of the current by a pulse $I > I_c$. Only triggering with a pulsed current assures very fast switching (μs-region and less). The superconductors used for these experiments are Nb-Ti-multifilament-wires with a copper-nickel matrix. Fast switching operation requires low-inductive breakers. Several types were tested, of which the double bifilar wound arrangements show the best results. The relation between the switching time or the commutation time on one hand and the rise time of the trigger

current pulse, the energy of the pulse, the direct current of the breaker before triggering and a few other electrical parameters on the other hand are determined experimentally. A pulse energy of 1 Ws is sufficient for triggering a 300 A-breaker. The current commutation from the breaker branch into a special ohmic load occurs within 1 μs. If a breaker is carefully manufactured the pulse energy increases nearly linear with the threshold maximum of the direct current of the breaker before triggering. The demonstration that during commutation an intrusion of electrical energy from the trigger-pulse-circuit into the main circuit never can be compensated completely is an important result of the measurements. (auth)

8856 SET OF COILS FOR MEASURING DIFFERENTIAL MAGNETIZATION PERPENDICULAR TO THE MAGNETIC FIELD OF A SUPERCONDUCTING SOLENOID. Filho, A.P.; Becerra, C.C.; de Oliveira, N.F. Jr. (Instituto de Fisica da Universidade de S. Paulo, C.P. 20516, São Paulo, S.P.,Brazil). Rev. Sci. Instrum. 46: No. 6, 789-790 (June 1975).

A set of coils for measuring differential magnetization perpendicular to an external dc magnetic field, provided by a superconducting solenoid of axial access, is described. Test measurements with the external field parallel to the easy axis of the antiferromagnetic $MnCl_2 4H_2O$ are shown. (auth)

8857 JOSEPHSON TUNNELING CURRENT IN THE PRESENCE OF A TIME-DEPENDENT VOLTAGE. Harris, R.E. (United Aircraft Research Laboratories, East Hartford, Connecticut 06108). Phys. Rev. B 11: No. 9, 3329-3333 (1 May 1975).

The expression for the current through a small Josephson tunnel junction in the presence of a time-dependent voltage is presented. Four terms appear: the usual sine, cosine, and quasiparticle terms, and a reactive part of the quasiparticle current. The latter is displayed graphically as a function of both energy and temperature. It is shown that in the limit of zero dc voltage and small ac voltage, the Josephson device behaves linearly. Interpretation of the in- and out-of-phase components of the current in this linear limit is given to provide physical insight into some of the details of the general expression. Finally, the tunneling current in the linear limit is shown for thin tunneling barriers to be proportional to the current in a single superconductor in the presence of an electromagnetic field. (auth)

8858 OBJECTIVE LENS FOR AN ELECTRON MICROSCOPE, USING SUPERCONDUCTIVE WINDING. Studenik, J. (CSAV, Brno). Slaboproudy Obz.; 34: No. 9, 417-420(Sep 1973). (In Czech).

The design described is centered about a cyrogenic system, made up of a small helium cryostat with a warm working space and a disc-shaped superconductive solenoid operated in the persistent condition. (Elect. Electron. Abstr.)

8859 AUTOMATED FLUX PUMP FOR ENERGIZING HIGH CURRENT SUPERCONDUCTING LOADS. Bernat, T. P.; Blair, D. G.; Hamilton, W. O. (Louisiana State Univ., Baton Rouge). Rev. Sci. Instrum.; 46: No. 5, 582-585(May 1975).

An automatic superconducting flux pump is described capable of energizing an inductive load to high currents (approximately 1000 A). These currents are derived from an inexpensive low current power supply and control circuits. (auth)

8860 SIMPLE PERSISTENT SWITCH FOR SUPERCONDUCTING SOLENOIDS. Isaac, R. D.; Schwarz, R. B. (Univ. of Illinois, Urbana). Rev. Sci. Instrum.; 46: No. 5, 638-639(May 1975).

The construction of a compact persistent switch for operating a superconducting solenoid in the persistent mode is described. It is easily built using only common laboratory materials. (auth)

8861 FREQUENCY DETUNING OF SUPERCONDUCTING CAVITIES BY HIGH-INTENSITY STREAMS OF ACCELERATED PARTICLES. Sayapin, A. F.; Fomenko, G. P. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 19: No. 4, 100-103 (Apr 1974).

Translated from Radiotekh. Elektron.; 19: No. 4, 797-800 (Apr 1974).

The question of the beam loading of superconducting cavities during the transit of bunches of accelerated particles in some equilibrium phase is examined, and it is shown that the effect of the frequency detuning of the cavity occurring in this situation is important. The optimal matching conditions of the accelerating system are obtained. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 10729, 10756, 10775, 11091, and 11094.

8862 (FEI-451) CALCULATION OF VELOCITY FIELDS AND PRESSURE IN A CYLINDRICAL DISTRIBUTING COLLECTOR. Nomofilov, E. V.; Romanova, T. M.; Filimonov, V. T. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 45p. (In Russian). Dep. NTIS (US Sales Only) $5.50.

A program is developed for calculating the velocity and pressure distribution by solving the equations of motion of a viscous liquid for two variants of the boundary conditions at the exit. A formula is obtained for calculating the boundary values of the velocity on taking into account the resistance of the lattice. The velocity distribution at the collector exit practically does not depend on the time after a brief initial moment. In addition the flow of liquid within the collector, especially at the near-bottom region, is non-steady-state. The coefficients of motion vary slightly along the radius of the collector, and can be assumed to be constant. The flow of liquid in a cylindrical collector turns out to be more stable than in a plane collector. (SJR)

8863 (FEI-458) HEAT EXCHANGE DURING BOILING OF A SODIUM-POTASSIUM ALLOY IN FREE CONVECTION CONDITIONS. Sorokin, D. N.; Kudryavtsev, A. P.; Brigutsa, V. I.; Zhirova, R. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 23p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

For a sodium-potassium alloy under conditions of free convection, different modes of heat removal are characteristic (heat removal of rather high heat fluxes by convection with subsequent removal of heat by evaporation from a free surface; heat removal during unstable and well-developed boiling). The existence of one mode of heat removal depends on the pressure, heat flux, and state of the heat transfer surface. In addition, the concentration of components has an effect on the mode of heat removal. For a sodium-potassium alloy of eutectic composition (78 wt % potassium) the degree of superheating required for boiling is somewhat lower than for sodium metal at the same absolute pressures, and the heat transfer coefficient over the range of pressures under study is higher than for sodium and potassium metals. Also the critical heat flux is higher than for sodium and potassium. A maximum in the critical heat flux is observed at a potassium concentration of ~15 to 20 wt % at a saturation pressure of ~0.2 kg/cm^2. The critical heat flux can be significantly increased by artificially introducing vapor-formation centers on the heat transfer surface. (SJR)

8864 (INR-1450/18/PP/B) ANALYSIS OF FLAT FINS WITH RADIATION HEAT TRANSFER. Madejski, J. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 19p. (In Polish). INIS.

Exact equation for flat and round fins was derived. Flat fins with variable thickness have been studied, and their dimensions optimized. (auth)

8865 (UCID-16457-74-4, pp 7-23) CODE DEVELOPMENT GROUP. Edwards, L. L. 1974.

In H-Division quarterly report, October-December 1974.

Activities in the development of the time-dependent, compressible fluid mechanics program are reported. The work is concerned with coupled-Eulerian-Lagrangian methods (CEL and CHAMP) as well as with generalized Eulerian-mesh method (GEMINI). The motivation in each case is related to developing codes (based on either known or new methods) that are aimed at solving several general classes of fluid-flow problems. (TFD)

8866 STUDY OF HEAT FLUX BURNOUT (CRISIS) IN CIRCULAR CHANNELS HAVING UNHEATED SECTIONS. Ornatskii, A. P.; Chernobai, V. A.; Vasil'ev, A. F. (Kiev Polytechnic Inst.). Teplofiz. Teplotekh.; No. 28, 25-27(1974). (In Russian).

A presentation is given of the results of an experimental investigation of critical heat fluxes during forced water circulation in circular channels having cold spots along the length. The operating parameters in carrying out the experiments were the following: mass velocities of 500, 1000 and 1700 kg/m^2-sec; pressures of 98.1, 147.2 and 186.5 bar; inlet water temperature from 20 to 250°C. It was found that values of the critical heat flux in channels with unheated sections of small length hardly differed from the critical heat flux with homogeneous heating. Increasing the length of the cold section led to a noticeable decrease (up to 50%) of the heat flux burnout in comparison with a homogeneous evolution of heat. With a large length of the cold section a noticeable decrease of 20 to 30% is observed in the critical power in comparison with an even distribution of heat flux. (SJR)

8867 BUBBLE GROWTH RATES IN NUCLEATE BOILING OF WATER AT SUBATMOSPHERIC PRESSURES. van Stralen, S. J. D. (Clarkson Coll. of Tech., Potsdam, NY); Sluyter, W. M.; Sohal, M. S.; Cole, R. Int. J. Heat Mass Transfer; 18: No. 5, 655-669(May 1975).

The growth rate of vapour bubbles has been investigated experimentally up to departure in water boiling at pressures varying from 26.7 to 2.0 kPa, the corresponding Jakob number increasing from 108 to 2689. Comparison of the data with existing theory

shows the substantial influence of liquid inertia during initial growth, in agreement with previous results of Stewart and Cole on water boiling at 4.9 kPa, the Jakob number varying from 955 to 1112. As an extreme case, at a pressure of 2.0 kPa, large "Rayleigh" bubbles are observed during the entire adherence time. During advanced growth, bubble behaviour is gradually governed by heat diffusion, especially at relatively high (sub-atmospheric) pressures. Experimental bubble growth in the investigated pressure range is in quantitative agreement with the van Stralen, Sohal, Cole and Sluyter theory. This model combines the Rayleigh solution with a diffusion-type solution, which accounts for the contributions to bubble growth due to both the relaxation microlayer (around the bubble dome) and the evaporation microlayer (beneath the bubble). Finally, a curious bubble cycle is observed at the lowest investigated pressures, which is attributed to the combined action of a high-velocity kiquid jet, originating in the wake following a large primary bubble, and a succeeding secondary vapour column generated at the adjacent dry spot at the heating wall beneath the primary bubble. (auth)

8868 EFFECT OF UPPER SURFACE CONDITIONS ON CONVECTION IN A SHALLOW CAVITY WITH DIFFERENTIALLY HEATED END-WALLS. Cormack, D. E.; Stone, G. P.; Leal, L. G. (California Inst. of Tech., Pasadena). Int. J. Heat Mass Transfer; 18: No. 5, 635-648(May 1975).

The effect of upper surface boundary conditions on the flow structure in shallow cavities with differentially heated end-walls is examined. Matched asymptotic solutions, valid for small cavity aspect ratios are presented for the following cases: uniform shear stress with zero heat flux, uniform heat flux with zero shear stress, and heat flux linearly dependent on surface temperature with zero shear stress. It is shown that these changes in surface boundary conditions have an important influence on the temperature and flow structure within the cavity. (auth)

8869 HEAT AND MASS TRANSFER BIBLIOGRAPHY. Luikov, A. V. Int. J. Heat Mass Transfer; 18: No. 5, 697-705 (May 1975).

Approximately 280 references of Soviet work on heat and mass transfer, published mainly in 1973, are listed. They are divided into fourteen sections under the headings of books, general, thermodynamics, thermophysical properties of substances, heat conduction, hydromechanics, forced convection, natural convection, capillary-porous bodies, phase conversions, radiation, combined heat and mass transfer, rheophysics, and heat pipes. (UK)

8870 CONVENIENT CORRELATION FOR HEAT TRANSFER TO CONSTANT AND VARIABLE PROPERTY FLUIDS IN TURBULENT PIPE FLOW. Sleicher, C. A.; Rouse, M. W. (Univ. of Washington, Seattle). Int. J. Heat Mass Transfer; 18: No. 5, 677-683(May 1975).

A recent equation for calculating heat-transfer coefficients to constant property fluids in pipes is modified to correlate variable property data. The correlating equation is of convenient form, applies to both liquids and gases, correlates constant propertv results within 10% for $0.1 < Pr < 10^4$ with $10^4 < Re < 10^6$ and correlates variable property data within 20% for $0.7 < Pr < 75$ with $10,000 < Re < 506,000$. The equation is compared with the Sieder Tate equation for liquids and the two equations of Petukhov for gases and liquids. Equations for heat transfer to variable property liquid metals are suggested. (auth)

8871 STUDY ON THE NUCLEATE POOL BOILING FROM SINTERED POROUS METAL SURFACE. Soo, J. Y. J. Korean Soc. Mech. Eng.; 13: No. 3, 41-55(1973).

Pool boiling of water from sintered porous copper-tin alloy upward-facing surfaces was experimentally studied under atmospheric pressure. The experiments indicated a major influence of the sintered porous metal surface on the ΔT necessary to sustain nucleate boiling at any given heat flux. This furnishes an answer to the wide variation in slopes of the curves showing the relation between heat flux and the temperature difference. The shape of the curve is expressed as follows: $q/A \propto \Delta T_m$(m = 0.31 ~ 0.88). On the sintered porous metal heating surface, the heat transfer coefficient was improved as the temperature difference decreased. The existence of the optimum sintered porous structure which was the maximum heat transfer coefficient was confirmed. Experimental equations were set up by making use of Nusselt number for the heat transfer coefficient, Reynolds number for the generating velocity of bubble on the surface, and Prandtl number for the material property. (Korean Sci. Abstr.)

8872 EFFECT OF THROTTLING ON HYDRODYNAMIC INSTABILITY AND BURNOUT IN A NATURAL CIRCULATING BOILING CHANNEL. Cho, Y. C. J. Korean Soc. Mech. Eng.; 13: No. 1, 65-70(1973).

An experimental study was performed in a natural circulating loop to investigate the effect of throttling position in a boiling channel upon the onset of instability and dynamic burnout, and was compared with the case without throttling. The following results were observed: (1) As the throttling position moves nearer the inlet of test section and as the inlet subcooling increases, the instability decreases. As the throttling position moves toward the exit and as the inlet subcooling decreases, the instability increases. The turning position is encountered around the middle of the test section. (2) Amplitude at the threshold of oscillation slightly increases as the throttling position moves toward the exit. A minute difference is observed between subcoolings, in the burnout, amplitude sharply increases as the throttling position moves to the exit and much difference is observed between subcooling. (3) Frequency at the threshold of oscillation and burnout proportionally increases as the throttling position moves to the exit, and it is dependent on the heat flux only under the constant subcooling. (4) Reverse flows appear from the middle throttling position and become more conspicuous as the position moves toward the exit. (Korean Sci. Abstr.)

8873 INCEPTION CRITERIA FOR DROPLET ENTRAINMENT IN TWO-PHASE CONCURRENT FILM FLOW. Ishii, M.; Grolmes, M. A. (Argonne National Lab., IL). AIChE (Am. Inst. Chem. Eng.) J.; 21: No. 2, 308-318(Mar 1975).

Inception criteria for droplet entrainment in concurrent gas-liquid film flow were developed from simple physical models. For film Reynolds number greater than or approximately equal to 160, an entrainment model based on the shearing off of roll-wave crests was used. At lower film Reynolds numbers, a wave undercutting mechanism was introduced. Experimentally observed abrupt changes in the critical gas velocity corresponding to the onset of entrainment at a certain film Reynolds number have been explained by the shift in the entrainment mechanisms. An agreement of the present inception criteria with various experimental data is shown to be satisfactory, and significant improvements over the existing empirical correlations have been made. (auth)

Materials Testing

Refer also to abstracts 9003 and 9387.

8874 (EUR-5099d,e,f) CONTINUOUS CONTROL BY GAMMA RAYS OF HOT STEEL ROUGH PRODUCTS. (Commission of the European Communities, Luxembourg). 1973. 166p. (In French). Dep. NTIS (US Sales Only) $11.50. EUR FB 185,-.

One of the most important problems in the economic operation of a primary rolling mill is the determination of the exact position of metallurgical faults. The studies made in the development of an installation with associated electronic equipment for the radiometric recording of faults and their exact spotting are reported in detail. The prototype installation developed has 15 measurement channels, a high response rate, and analog and logic processing devices to locate the defective part of the rough steel products. The characteristics of the measurement device and the analog locating device are reported. (JSR)

8875 (KFK-2116) ULTRASONIC MEASUREMENT TECHNIQUE IN SYSTEMS UNDER SODIUM. Rohrbacher, H. A.; Bartholomay, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Mar 1975. 87p. (In German). Dep. NTIS (US Sales Only) $7.50.

Different versions of acoustic sensors were investigated and tested in a water model with a view to novel ultrasonic detection methods to be applied in systems under sodium. The advantages and drawbacks of acoustic waveguides are discussed and compared with the properties of so-called direct sensors, taking into account the high temperatures in the environment. A new high-temperature piezoelectric material as well as the technology of direct sensor manufacturing are presented. The results of various methods of piezoelectric crystal bonding with the stainless steel diaphragms are described and explained by means of oscillograms. Finally, estimates are given for an ultrasonic sweep arm with respect to the extent of errors of the detected objects and the sonic beam distortions in detection areas with sodium layers of different temperatures. (auth)

8876 (LA-UR-75-595) QUANTITATIVE PULSED EDDY CURRENT ANALYSIS. Morris, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 20p. (CONF-750463-1). Dep. NTIS $4.00.

From 10th symposium on nondestructive evaluation; San Antonio, Texas, USA (23 Apr 1975).

The potential of pulsed eddy current testing for furnishing more information than conventional single-frequency eddy current methods has been known for some time. However, a fundamental problem has been analyzing the pulse shape with sufficient precision to produce accurate quantitative results. Accordingly, the primary goal of this investigation was to: demonstrate ways of digitizing the short pulses encountered in PEC testing, and to

develop empirical analysis techniques that would predict some of the parameters (e.g., depth) of simple types of defect. This report describes a digitizing technique using a computer and either a conventional nuclear ADC or a fast transient analyzer; the computer software used to collect and analyze pulses; and some of the results obtained. (auth)

8877 NEUTRON RADIOGRAPHY: PRESENTATION OF A NEW METHOD FOR NONDESTRUCTIVE TESTING. Alcober Bosch, V. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 18: No. 92, 403-416(1974). (In Spanish).

A review is given of the various mechanisms intervening in the neutron radiographic technique with emphasis on the basic physics of these mechanisms. The complete radiographic process, neutron production, and neutron channeling in the form of a beam with the necessary characteristics are described. The most interesting applications of this technique are discussed and illustrated with examples. The neutron radiographic installation at JEN-1 is described. (tr-auth)

8878 MACROSTRUCTURE X-RAY RADIOGRAPHY OF IRRADIATED REACTOR FUEL RODS BY AN 18 MeV BETATRON. Tucek, J. pp 89-105 of Reports from the Hot Cells. Karlsruhe, F. R. Germany; GfK (Apr 1974). (In German).

10 figs.; 3 refs. Available from the GfK.

Extensive preliminary tests were carried out with the common X-ray equipment used in industrial macrostructure testing to investigate the test objects with high fission product activity. Test pictures were made with 300 kV and 400 kV X-radiation, with Ir 192-γ-radiation, with 18 MeV betatron X-radiation, with an X-ray flash tube and with thermal neutron radiation. The picture discernibility of concentric axial bores in rod-shaped UO_2 specimens was chosen as criteria for the best method of investigation. A final assessment of the various irradiation methods showed that the betatron radioscopy is technically the most favourable testing method in a 'hot cell' for single, irradiated fuel rods and fuel rod specimens as well as for complete irradiation capsules. (auth)

Nuclear Explosions

Refer also to abstracts 8909–8910, and 9021.

8879 (UCID-16457-74-4, pp 43-54) COMPUTER SIMULATION GROUP. Norris, D. M. 1974.

In H-Division quarterly report, October–December 1974.

This newly created group is responsible for calculations in the area of solid mechanics. The objective is to build in-house expertise both in the Lagrangian finite-difference HEMP-type codes and in the finite-element codes traditionally used in structural statistics and dynamics. Emphasis at this time, in addition to particular interesting applications of the software, is to disseminate the division's software and to educate potential users. Activities reported on include HEMP ground motion simulation of the Portmanteau Nuclear Test, three-dimensional heat transfer code development (HEAT3D), progress with HEMP3D, graphics improvements in VPIX3D, three-dimensional analysis of a turbine stator (DTVIS2), and HEMP and finite-element code comparison studies. (TFD)

8880 (UCID-16457-74-4, pp 55-69) SPECIAL PROJECTS GROUP. Wilkins, M. L.; Henry, C. R. 1974.

In H-Division quarterly report, October–December 1974.

In the Special Projects Group, individuals or small groups work on new projects or special problems. The work is relatively short-term and does not logically fit into the other four H-Division groups. Projects underway include calculations on stress intensity factors in crack propagation, an improved materials properties model, a liquid metal EOS, and significant effort on various three-dimensional programs for the STAR-100. Activities reported on include numerical analysis of underground nuclear explosions (HEMP), CEL-HEMP calculation of subsurface explosion, studies in fracture mechanics, a scheme for developing the nonlinear heat-Eulerian code for the STAR-100, and H-Division Data Reduction Center. (TFD)

8881 INSENSITIVE EXPLOSIVE. Benziger, T. M. (to U.S. Energy Research and Development Administration). US Patent Application 528,380. Filed date 29 Nov 1974. 11p.

A highly insensitive and heat resistant plastic-bonded explosive containing 90 wt percent triaminotrinitrobenzene and 10 wt percent of a fully saturated copolymer of chlorotrifluoroethylene and vinylidene fluoride is readily manufactured by the slurry process. (auth)

8882 FAST DATA ACQUISITION SYSTEM. Nelson, M. A.; Davies, T. J.; Clark, J. C. (to U.S. Atomic Energy Commission). US Patent 3,867,627. H04b9/00. 18 Feb 1975. Filed date 8 Jan 1974. 7p.

PAT-APPL-431,809.

A data acquisition system for obtaining detailed information on fast, transient electrical signals, especially nuclear explosion detection systems is described. The signal to be recorded is applied as a traveling wave to a longitudinally extending electro-optical modulator. Light pulses are applied to a plurality of locations along one side of the modulator and modulated pulses representative of the intensity of the electrical signal at those locations received on the opposite side and further processed such as by conversion to digital. (auth)

8883 SOME RELATIONS BETWEEN ENERGY YIELD OF ATMOSPHERIC NUCLEAR TESTS AND GENERATED INFRASONIC WAVES. Flores, J.S.; Vega, A.J. (Observatorio San Calixto, La Paz, Bolivia). J. Acoust. Soc. Am. 57: No. 5, 1040-1043 (May 1975).

The relation between energy yield in megatons (MT) of atmospheric tests during 1968–1971 at French Polynesia and infrasonic waves recorded at Peñas in Bolivia (a distance of approximately 7300 km) is studied. Yields were estimated from period and amplitude of the early portion of the waveforms using the theoretical relation of Pierce and Posey [Geophys. J. R. Astron. Soc. 26, 341–368 (1971)]. In the present paper, the relation of this derived yield to the power spectrum of major portions of the waveforms is investigated. The magnitude of the square root of this spectrum that can be considered proportional to the Fourier integral for a yield sample time (i.e., spectral amplitude) typically has two characteristic peaks, the first of which appears to nearly directly proportional to yield, the proportionality constant being 300 μbar $sec^{1/2}$/MT. Another waveform feature exhibiting strong correlation with yield is the time duration of the gravity wave train which precedes the acoustic mode waves. For smaller yields, this also appears to vary nearly linear with yield, the proportionally constant being 1000 sec/MT up to about 1 MT. The application of these conclusions to other source-receiver geometries and to other meteorological conditions remains a topic for future study. (auth)

8884 NUCLEAR CHEMICAL MINING OF PRIMARY COPPER SULFIDES. Lewis, A. E.; Braun, R. L. Trans. Soc. Min. Eng. AIME; 254: 217-224(1973).

A contained nuclear explosion is proposed to produce a chimney of broken ore well below the water table. After the chimney is filled with water and reaches hydrostatic equilibrium, O, under pressure, is introduced near the bottom of the mass of broken rock. The increase in solubility of O at high hydrostatic pressure is sufficient to initiate the oxidation of the primary sulphides, chalcopyrite and pyrite. The oxidation and dissolution of these sulphides produce enough heat to increase the temperature of the ore and water in the chimney as much as 100 to 150°C. The rate of dissolution of chalcopyrite exposed to O-saturated solutions becomes so rapid under these conditions that the rate of Cu extraction becomes limited to the accessibility of chalcopyrite to the solutions. Means of solution control and distribution of O in the chimney have been examined in some detail. A calculational model utilizing experimentally determined solubility rates is utilized to estimate the temperature rise in the chimney and the rate of Cu recovery as a function of initial temperature, sulphide content of ore and size of ore particles. It is concluded that the high pressure and high temperature obtainable in a large ore mass broken by nuclear explosives promise the rapid and economic recovery of minerals not considered soluble by conventional in situ leaching methods. The method should be broadly applicable to the kinds of deep deposits that must be depended on for future production and with minimum disruption of the environment. (Metals Abstr.)

Protective Structures and Equipment

Refer also to abstract 8613.

8885 (BISI-11902) BORON/GYPSUM: A NEUTRON-ABSORBENT BUILDING MATERIAL. Ertl, H. H.; Bodemann, M.; von Erichsen, L. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Medizin). 1975. 9p.

Translated from German, Eurisotop; 2: No. 55, 1113-1122 (1972).

The advantages of boron/gypsum as a building material are high compressive strength and a high rate of neutron absorption. Fast neutrons are absorbed by a film containing hydrogen. The results of detailed absorption tests are presented; boron is particularly effective in these, and can be combined with gypsum to produce an effective building material. (auth)

8886 SHIELDED LABORATORY INSTALLATIONS IN THE ATTACHED BUILDING. Kathol, W. pp 39-50 of Reports from the Hot Cells. Karlsruhe, F. R. Germany; GfK (Apr 1974). (In German).

5 figs. Available from the GfK.

The shielded laboratory installations attached at present to the concrete cells of the hot cell plant are designed for 500

metallographic samples as well as 300 material and 100 creep tests per year. The installations in the concrete cells allow a greater sample throughput. The newly erected laboratory installations are described. The concrete cells having a thickness of 91.5 cm permit the handling of α-activities and shield γ-activities up to 10^7 Ci (1 MeV). The samples to be handled in the laboratory installations each have a γ-activity of 1 to 2×10^3 Ci. Lead and steel can be advantageously used here for shielding. The small wall thicknesses necessary with these materials compared to concrete enables the accommodation of the required number of working places in a relatively small building extension, thus keeping the costs of the annex low. As the tasks set for the laboratory installations can change after the termination of the presently foreseeable investigations, the installations were designed to be as flexible as possible. A new type of shielding construction was developed where most of the shielding parts can be interchanged or newly replaced. (auth)

8887 PROCEDURE OF THE OCCUPANCY OF INSTALLATIONS IN THE HOT CELLS, BUILDING 701 IN THE YEAR 1972. Enderlein, H. pp 51-75 of Reports from the Hot Cells. Karlsruhe, F. R. Germany; GfK (Apr 1974). (In German).

With figs. Available from the GfK.

A review is given with the help of diagrams on the running of the cell and installation occupancy since the commissioning of the whole plant. (auth)

8888 DESCRIPTION OF THE PLANT 'HOT CELLS' BUILDING 701. Scheeder, M. pp 3-37 of Reports from the Hot Cells. Karlsruhe, F. R. Germany; GfK (Apr 1974). (In German).

With figs. available from the GfK.

The plant building 701 - hot cells - whose whole concept originates from the years 1960/61 is described including sectional drawings. During the construction period of the building, the equipment was designed and realized according to the experience and viewpoints available at the time. No part of the plant was unserviceable, many ideas were valid for other 'hot cells'. The equipment of the plant is continually changing and being adapted to experience and tasks. Particular attention was paid to the radiation protection systems of the plant as these form the basis for secure, safe operation. Processes were developed for the monitoring of air in cooperation with 2 firms, which today are a standard part of these types of plants. The accident-free operation of the plant for over 8 y confirms that all safety measures work well together. (auth)

Vacuum Engineering

8889 SIMPLE DEVICE FOR MEASUREMENTS OF THE STICKING COEFFICIENT OF CRYOPUMPS. Habets, A. H. M.; Verster, N. F.; van Vlimmeren, Q. A. G. (Univ. of Technology, Eindhoven, Netherlands). Rev. Sci. Instrum.; 46: No. 5, 613-616 (May 1975).

An apparatus is described which allows direct measurements of the reflection coefficient of cryopumps, the complement of the sticking coefficient. The reflected fraction of a gas flow directed towards a cryopump is measured directly. This gives accurate results especially for high sticking coefficients. Measured values greater than or equal to 0.995 of the sticking coefficient of nitrogen gas on a 16 K cryopump are presented as a function of the gas flow per unit area of the pump. The density of the condensed layer is nearly the same as for solid nitrogen ice. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Refer also to abstract 9976.

Minerals and Ores

Refer also to abstracts 8526 and 8943.

8890 (N-75-11413) EXPLORATION FOR FOSSIL AND NUCLEAR FUELS FROM ORBITAL ALTITUDES. Short, N. M. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Nov 1974. 59p. (NASA-TM-X-70781; X-923-74-322). NTIS $4.25.

Results from the ERTS program pertinent to exploration for oil, gas, and uranium are discussed. A review of achievements in relevant geological studies from ERTS, and a survey of accomplishments oriented towards exploration for energy sources are presented along with an evaluation of the prospects and limitations of the space platform approach to fuel exploration, and an examination of continuing programs designed to prove out the use of ERTS and other space system in exploring for fuel resources. (auth)

8891 (NP-20388) ASSESSMENT OF URANIUM AND THORIUM RESOURCES IN THE UNITED STATES AND THE EFFECT OF POLICY ALTERNATIVES. Foley, L. M.; Harris, J. L.; Pittman, D. C. (eds.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1974. 223p. National Sci. Foundation, Washington, DC 20550.

Objectives of this study were to analyze the known United States uranium/thorium resources and to determine the effect of various policy options on the availability of these resources. It was concluded from this study that, in general, uranium and thorium resources in the U. S. are extensive, but new or improved technology and higher prices are required before they will become economically viable. Five specific conclusions reached during this study were: (1) Reasonably assured uranium reserves recoverable at a 1974 forward cost of $15/lb U_3O_8 should be adequate at least through 1985. (2) Uranium resources from conventional sandstone deposits recoverable at a 1974 forward cost of $30/lb U_3O_8 should be adequate to the year 2000; (3) Thorium resources should be adequate to supply all conceivable needs through the year 2000; (4) Capital and manpower resources may be inadequate in the near future; and (5) Production capacity may be inadequate in the short term. (LK)

8892 (RMO-465) REPORT ON CALAMITY DISTRICT, UNCOMPAHGRE UPLIFT AREA, COLORADO. Metzger, O. H. (Union Mines Development Corp., Grand Junction, Colo. (USA)). 22 Jan 1945. 28p. GJO.

Mineralization of the Salt Wash member of the Morrison formation in the Calamity District Uncompahgre Uplift Area of Mesa County, Colorado was studied by field investigations and surveys of old mines. Topographic maps of the mineralized areas were prepared. The topography, physiography, stratigraphy, and geologic relations of the area are described. Data are presented on the past production of uranium and vanadium ores and estimates of uranium reserves and mining costs are included. (CH)

8893 CRYSTAL CHEMISTRY OF THE URANYL SILICATE MINERALS. Stohl, F. V. University Park, PA; Pennsylvania State Univ. (1974). 124p. University Microfilms Order No. 75-9848.

Thesis (Ph. D.).

Uranyl silicate minerals were divided into three groups on the basis of their uranium to silicon ratios. The 1:1 group contains the more common uranyl silicate minerals including uranophane and boltwoodite. The crystal structure of uranophane was refined and the locations of the water molecules were determined. The structure of boltwoodite was also determined. The members of this group are composed of uranyl silicate chains which crosslink to give uranyl silicate sheets. The structure type for the 1:3 uranium to silicon group was determined from a partial structure analysis of the mineral weeksite. This structure is composed of uranyl silicate chains which are crossbonded by the additional silica tetrahedra in the structure. A structure model for the 2:1 group has been determined from a partial structure analysis on a synthetic uranyl germanate by Legros et al., (1972). This structure is composed of uranyl silicate chains which crossbond by sharing a single silica tetrahedron to give a three dimensional framework type structure. A possible new mineral was also found during this work. The locations of the uraniums in this structure indicate that its structure should be closely related to those of the other uranyl silicate minerals. (Diss. Abstr. Int., B)

8894 PERSPECTIVES OF RADON WATER SEARCHES IN THE REGION OF MOLDAVIAN ARTESIAN BASIN. Karabulya, A. K.; Kozlova, E. V. Vestn. Leningrad. Univ., Geol., Geogr.; 18: No. 3, 130-133(Sep 1974). (In Russian).

Radon waters within the range of Moldavia artesian basin have been found. The search for such waters should be continued in north-eastern Dniestr area in the localities of Archean and Proterozoic breaks. Seventeen such localities were mapped. Radon dispersion sureoles are not large and thus the holes should be made only in the break area. (auth)

8895 GRANITE AND MINERALIZATION OF URANIUM IN THE SWISS ALPS. Labhart, T. P. (Bern Univ. (Switzerland). Mineralogisch-Petrographisches Inst.); Rybach, L. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Kristallographie und Petrographie). Geol. Rundsch.; 63: No. 1, 135-147(1974). (In German).

The radioactivity of 4 Hercynian granitic rock units of the Swiss Central Massifs (Mont Blanc granite, Vallorcine granite, Giuv syenite and Central Aare granite s.l.) has been measured in the field (on the surface and in tunnels) and in the laboratory (gamma ray spectrometry). Each rock unit shows a clearly defined field of variation on a U-Th plot. The Th/U ratios decrease with increasing Th contents. The variation is petrologically controlled: the U and Th contents increase in the border zones of the granitic bodies and, in the case of intrusive sequences, in the younger derivates, especially in the aplitic phase. Three of the units show unusually high U and Th contents: Giuv syenite (mean of 44 determinations), 22 ppM U and 66 ppM Th; Mont Blanc granite (45), 19 ppM U/31 ppM Th; Central Aare granite s.str. (10), 13 ppM U/32 ppM Th. The fraction of easily leacheable uranium is, according to fluorimetric determinations, unusually high (up to 90%) in some granites. Generally, the higher the U content, the higher the leacheable fraction. In all rock units uranium mineralizations (mainly pitchblende) were found. They are confined to shear zones, mylonites and fissures and occur mostly in the border zones of the granitic bodies or in the vicinity of especially uranium-rich rock types, such as aplites. Apart from the effects of the Alpine orogeny the association of uranium mineralizations with granites shows close similarities to the occurrences in the French Massif Central. (auth)

8896 POSSIBILITIES OF URANIUM PRODUCTION FROM NORTH SEA WATER. Schmidt-Mende, P. (Krupp (Friedr.) G.m.b.H., Essen (F. R. Germany). Forschungsinstitut). Meerestech./Mar. Technol.; 5: No. 2, 61-63(Mar 1974). (In German).

Water samples from the areas of the German North Sea coast were analyzed to investigate possibilities of uranium production from the water of these areas. The uranium contents found were: Bay of Heligoland 3.6 μg U/l, river Elbe up to 8.2 μg U/l, river Weser approximately 3.3 μg U/l, and river Ems less than 1 μg U/l. The use of inorganic sorption material for the uranium enrichment appears to have the greatest chances of success. The production from sea water, however, cannot be carried out economically with the means known today. (auth)

8897 ASPECTS OF RESEARCH AS TO THE PROSPECTING OF URANIUM. Tasks, developments, Results. Dahlkamp, F. (Uranerzbergbau G.m.b.H. und Co. K. G., Bonn (F. R. Germany)). Erzmetall.; 27: No. 9, 425-428(Sep 1974). (In German).

From 10th session of the GDMB discussion meeting on raw materials economy; Bonn, F. R. Germany (15 Nov 1973).

Three fields of research, development of new methods of investigation and the respective measuring instruments, modification of known methods and techniques of measurements, and basic research with respect to the deposit and its geology, are demonstrated with the aid of some examples of prospecting and the experiences gained with them. A brief description of novel developments in ore processing is given and their importance as to the valuation of uranium ore deposits is shown. (GE)

8898 THE EXPOSURE OF CANADIAN URANIUM-ORE OCCURRENCES. Floeter, W.; Szeimies, B. Metall; 28: No. 7, 736-738(Jul 1974). (In German).

Following an introductive evaluation of longer range uranium supplies, the preliminary construction works on the Rabbit Lake project in Saskatchewan, Canada are described. The opencast working of uranium ores is expected to produce about 2,000 metric tons per year of yellow cake. Novel methods of ore processing are applied. The infrastructure of the plant is adjusted to the particular conditions of the country. The storage of overburden as well as the clarification of the processing sludges is performed with respect to a maximum environmental protection. (GE)

8899 NEW VARIETY OF PYROCHLORE: CERURANOPYROCHLORE. Lin, T. S.; Hung, W. H.; Shih, T. M. Geochimica (Engl. Transl.); 1: No. 1, 38-43(1973).

Translated from Ti Ch'iu Hua-hsueh; 1: No. 1, 39-45(1973).

The formation of ceruranopyrochlore is related to metasomatic replacement at the contact between aegirine pegmatite and alka-

line skarn. Such occurrence is reflected in the chemical composition, in that the mineral contains particularly more Nb than Ta, and more cerium rare earths than heavy rare earths (Tb to Y). However, the higher uranium content relative to thorium in ceruranopyrochlore contrasts with the opposite relations observed in alkaline pegmatite and skarns. The chemical composition of ceruranopyrochlore is complicated and highly variable. The complexity may result from the extensive effect of both coupled and simple ionic isomorphic substitution. (auth)

8900 URANIUM MINERALIZATIONS IN QUATERNARY VOLCANITES OF THE LAZIO REGION. Locardi, E. (CNEN, Casaccia, Italy). Boll. Soc. Geol. Ital.; 92: 541-566(1973). (In Italian).

In the Quarternary alkaline volcanites of the Northern Lazio region, there have been discovered in the last few years extensive uranium deposits. The uranium is concentrated in thin peneconcordant layers, into reworked tuffs, and tuffites which are kaolinized and impregnated with iron sulphides. Uranium deposits are near the surface (from a few meters to about a hundred meters deep), very extensive (several km^2) but low grade (from a few hundred to a few thousand g/t). Uranium ores are distributed in several overlying layers of thickness of the order of a meter. The mineralizations are related to the supergene environment: uranium leached from volcanites in the overlying basin is moved by groundwater into the aquifer system of volcanosedimentary basins, where it becomes reduced and precipitated. The genesis is thus similar to the one for the large peneconcordant sandstone-type uranium deposits of the intracratonic basins in the central U.S.A. The main difference consists however in the shortness of the mineralization formation period — much less than a million years as compared to the tens or hundreds of million years which is the time of the known sandstone-type uranium deposits. (auth)

8901 VARIATIONS IN THE CONTENT OF URANIUM IN EUDIALYTE FROM THE DIFFERENTIATED ALKALINE ILIMAUSSAQ INSTRUSION, SOUTH GREENLAND. Contribution to the Mineralogy of Ilimaussaq, No. 36. Steenfelt, A. (Groenlands Geologiske Undersoegelse, Copenhagen); Bohse, H. Lithos; 8: No. 1, 39-45(1975).

Uranium analyses by the fission-track method on eudialytes from the under-saturated rocks of the Ilimaussaq intrusion demonstrate that uranium enters eudialyte in isomorphous substitution. The content of uranium in the eudialytes varies with the crystallization of the magma in two ways. In the downwards-crystallizing roof rocks, eudialyte is interstitial and the content of uranium in eudialyte decreases with proceeding crystallization, whereas in the bottom rocks, formed by upwards accumulation of liquidus minerals including eudialyte, the uranium content in eudialyte increases with crystallization. The reason for the abnormal trend in the roof rocks is discussed and compared with similar trends elsewhere. (auth)

8902 ON A POSSIBLE APPLICATION OF MOESSBAUER EFFECT OF OPTICAL ANALOGUE IN MINERALOGY (ON EXAMPLE OF FLUORITE). Smolyanskij, P. L. (Vsesoyuznyj Nauchno-Issledovatel'skij Geologorazvedochnyj Inst., Leningrad (USSR)). Zap. Vses. Mineral. Obshchest.; No. 2, 272-278(1974). (In Russian).

With fluorite as an example a look is taken at the possibility of using, during reconstruction of the conditions of mineral formation, the spectroscopic parameters of a phonon-free line of crystal lattice defects of an individual mineral. Effects of various factors on the spectral parameters of the phonon-free lines of impurity Eu^{2+} ions and of uranium-oxygen complexes in the crystal lattice of fluorite were studied. Data are presented on regularities between the spectral parameters and various physical and crystal-chemical properties of the crystals under study. (tr-INIS)

Radioactive Effluents

Refer also to abstracts 8610, 8912, 8914, 9007, and 11063.

8903 EXPERIENCE WITH THE RELEASE OF RADIOACTIVE SEWAGE FROM A MEDICAL AREA. Kaul, A.; Loose, W. (Freie Univ. Berlin (F. R. Germany). Klinikum Steglitz). Kerntechnik; 17: No. 2, 81-88(Feb 1975). (In English, German).

The operation of, and reports on 3 years of operating experience with, a sewage system for the disposal of radioactive sewage from the nuclear medicine area of the Steglitz Clinic of the Berlin Free University are described. The facility consists of several sewage strands and tank groups which make it possible to store radioactive sewage provisionally and, after measuring the activity concentrations, to release this sewage in a controlled manner into the general sewage flow of the Clinic. Under the operating conditions of the facility as described, the release of ^{131}I into the general sewage flow of the Clinic during the reporting period did not exceed 16% of the produced quantity of ^{131}I. The activity concentration in the general sewage of the Clinic was 20% of the MPC for ^{131}I. The possibilities of optimization and rationalization of this and other comparable facilities are discussed. (auth)

8904 RADIOACTIVE EMISSION FROM POWER STATIONS FIRED WITH RHINELAND SOFT COAL. Kirchner, H.; Marz, E.; Schiffers, A. (Kernforschungsanlage, Juelich, Ger.). Braunkohle; 26: 340-345(1974).

The thorium and uranium concentrations in Rhineland soft coal before and after burning are determined. An attempt is made to compare the radioactive materials emitted from nuclear and coal-burning power plants. (ERB)

Radioactivity Monitoring and Transport

Refer also to abstracts 8913, 8983, 9227, and 9637.

8905 (BNWL-1950(Pt. 1), pp 131) RADIONUCLIDES IN RICHLAND SCHOOL CHILDREN. Nelson, I. C.; Endres, G. W. R. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

An investigation was initiated on the occurrence of certain gamma-emitting radionuclides, notably ^{137}Cs, in local residents. The objective of this investigation is to verify the presence or absence of Hanford radioactive wastes in Hanford residents as a result of possible ground water and Columbia River contamination. Cesium-137 is the principal radionuclide of interest since it has a long half-life (30 years) and could persist in ground water for some time. Because ^{137}Cs has also occurred in fallout and from nuclear testing, small amounts are expected to occur in people from that source. Measurement of ^{137}Cs in control groups whose drinking water is not derived from ground water which could be contaminated by Hanford wastes or from the Columbia River is therefore necessary. The subjects chosen for these studies are Richland school children, primarily because knowledge of the occurrence of radioactive nuclides in these individuals is highly important and because they will be available for repeated examinations over the years. Preliminary analysis of the data suggests that no unusual results will be found. Only very small amounts of ^{137}Cs were found, in addition to the naturally occurring radionuclide, ^{40}K. (auth)

8906 (COO-1156-80) RADIOECOLOGY OF NATURAL SYSTEMS IN COLORADO. Thirteenth Technical Progress Report, May 1, 1974-April 30, 1975. Whicker, F. W. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). 1 May 1975. Contract AT(11-1)-1156. 108p. Dep. NTIS $8.50.

Progress is reported on studies on the behavior of fallout radionuclides (^{137}Cs and ^{90}Sr) in selected organisms and natural ecosystems in Colorado. Components of alpine tundra, montane forests, shortgrass plains, and freshwater lakes and streams are currently under investigation with respect to behavior and effects of radionuclides. Studies on mule deer centered largely on maintenance of a captive deer colony and improvement of husbandry techniques. Because of these efforts, we are in a good position to conduct metabolic studies on plutonium. A study on the effect of gut passage on the mean diameter of monodisperse PuO_2 microspheres was initiated. Collections of wild deer from natural winter range areas in the Cache la Poudre Drainage have continued to provide data for long-term trend analysis of ^{137}Cs in muscle and ^{90}Sr and ^{239}Pu in bone and short-term information on ^{131}I in thyroids. Studies on plutonium in the terrestrial environs of Rocky Flats were initiated in the summer of 1972. Progress has been made at Rocky Flats in terms of initiating studies to evaluate intercompartmental transport pathways and rates, and studies to evaluate the status and health of selected populations and biotic communities. Soil movement measurements were conducted to bear on the question of plutonium stability in contaminated areas. The relative importance of root uptake versus aerial deposition was evaluated in the field utilizing a sod block transplant procedure. The role of pocket gophers in moving plutonium-contaminated soil was investigated. A substantial number of small rodents were examined for possible pathological conditions which might arise from inhabiting a plutonium-contaminated area. Lead studies in alpine lake systems were continued and the lead flux through the Snow Lake ecosystem was measured. This was done by measuring rates of input via precipitation and rates of loss via the outflow. Such measurements were made on a seasonal basis to provide reasonable annual estimates of income and loss. A lead budget for the lake can be estimated from data gathered in 1973. The study on radiation effects on shortgrass plains

vegetation was continued with emphasis on long-term changes in community structure under chronic irradiation stress and recovery patterns in areas which received 30 day radiation exposures and other forms of stress in 1969. (auth)

8907 (DOCKET-50201-166) WEST VALLEY REPROCESSING PLANT. Environmental Report No. 17, July–December 1975. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 28 Feb 1975. 57p. Dep. NTIS $6.00.

During the last half of 1974, over 700 separate analyses of air, water, milk, fish, deer and silt were performed. These analyses indicated the concentrations of radioactivity in the environment are far less than the applicable limits of the U. S. Nuclear Regulatory Commission and the Federal Radiation Council. The average long lived airborne radioactivity around the NFS site for the last half of 1974 remained slightly higher than samples from previous years. This may be attributed to atmospheric nuclear explosions set off by the Peoples Republic of China. Discharges of radioactivity from the lagoon system remain the same as during the first half of 1974. The concentrations of radionuclides in Cattaraugus Creek during the last eight months of 1974 average 1.5 percent of MPC with a maximum observed concentration of 2.2 percent of MPC and a minimum of 0.7 percent of MPC. ^{129}I concentrations in Cattaraugus Creek during October and November are not yet available. However, ^{129}I has historically been an insignificant percent of MPC determinations, and are not expected to change the stated MPC values. Levels of ^{90}Sr in Cattaraugus Creek fish bone increased slightly during the 2nd quarter of 1974. This increase may be attributed to entrainment of bottom silt during the spring high water conditions. Concentrations decreased in fish sampled during the 3rd quarter of 1974. (auth)

8908 (PROT.SAN.-03/74) DATA ON ENVIRONMENTAL RADIOACTIVITY COLLECTED IN ITALY (JANUARY–DECEMBER 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1974. 221p. Dep. NTIS (US Sales Only) $14.25.

The following data from national networks are reported: gross beta radioactivity in air at ground level; ^{89}Sr, ^{90}Sr, ^{137}Cs, ^{95}Zr, and ^{239}Pu content of fallout samples; ^{137}Cs and ^{90}Sr content of geographical waters, irrigation waters, drinking water, sea water, milk, bread, and vegetables; and ^{137}Cs content of beef. Data from local networks include maps of collection stations for radiation monitoring of the environs of research centers and nuclear power plants; gross beta radioactivity in air and fallout deposits; and ^{137}Cs and ^{90}Sr content of air, water, milk, vegetables, and fish. (HLW)

8909 (UCID-16581(Rev.2)) ESTIMATES OF SURFACE DEPOSITION OF RADIOACTIVITY AND RADIATION DOSES RESULTING FROM PROPOSED NNTRP ACTIVITIES. Gudiksen, P. H.; Peterson, K. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1975. Contract W-7405-Eng-48. 70p. Dep. NTIS $6.50.

The National Nuclear Test Readiness Program (NNTRP) has been developed by the AEC (now ERDA) and DOD to maintain a state of readiness for the prompt resumption of atmospheric nuclear testing if circumstances warrant such resumption. Such proposed tests would be conducted at the Pacific Test Site. The environmental consequences of the program were assessed. Estimations were made of the magnitude and distrioution of radioactive debris deposited on the surface waters of the Pacific Ocean as a result of the test and of the total person-rem to the Continental U. S. and Hawaiian Islands populations. Since the proposed test series consists of a wide range of weapon yields to be detonated at various altitudes and the specific number and types of tests change with time according to national defense needs, a set of seven representative tests were selected for performing a parametric yield analysis at various burst locations and heights. The yields were selected to cover the low intermediate, intermediate, and low megaton ranges. The respective yields, detonation heights, and ground zero locations of the seven bursts were considered. The atmospheric transport and diffusion models that were used are described and the meteorological and radiological input data used, and the results of the calculations are included. (auth)

8910 (UCID-16790) GLOBAL DOSE TO MAN FROM PROPOSED NNTRP HIGH ALTITUDE NUCLEAR TESTS. Peterson, K. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1975. Contract W-7405-eng-48. 19p. Dep. NTIS $4.00.

Radionuclide measurements from past high altitude nuclear testing have enabled development of a model to estimate surface deposition and doses from 400 kt of fission products injected in winter within the Pacific Test Area at altitudes in excess of 50 km. The largest 30-year average dose to man is about 10 millirem and occurs at 30^0 to 50^0N latitude. The principal contributor to this dose is external gamma radiation from gross fission products. Individual doses from ^{90}Sr via the forage-cow-milk pathway and ^{137}Cs vi.. the pasture-meat pathway are about 1/5 the gross fission product doses. The global 30-year population dose is 3×10^7 person-rem, which compares with a 30-year natural background population dose of 1×10^{10} person-rem. Due in large part to the global distribution of population, over 98 percent of the global person-rem from the proposed high altitude tests is received in the Northern Hemisphere, while about 75 percent of the total population dose occurs within the 30^0–50^0N latitude belt. Detonations in summer would decrease the global dose by about a factor of three. (auth)

8911 SIZE DISTRIBUTION OF RADON DAUGHTER PARTICLES IN URANIUM MINE ATMOSPHERES. George, A. C.; Hinchliffe, L.; Sladowski, R. (Atomic Energy Commission, New York). Am. Ind. Hyg. Assoc. J.; 36: No. 6, 484-490(Jun 1975).

The size distribution of radon daughters was measured in several uranium mines using four compact diffusion batteries and a round jet cascade impactor. Simultaneously, measurements were made of uncombined fractions of radon daughters, radon concentration, working level, and particle concentration. The size distributions found for radon daughters were log normal. The activity median diameters ranged from 0.09 mu m to 0.3 mu m with a mean value of 0.17 mu m. Geometric standard deviations were in the range from 1.3 to 4 with a mean value of 2.7. Uncombined fractions expressed in accordance with the ICRP definition ranged from 0.004 to 0.16 with a mean value of 0.04. The radon daughter sizes in these mines are greater than the sizes assumed by various authors in calculating respiratory tract dose. The disparity may reflect the widening use of diesel-powered equipment in large uranium mines. (auth)

Atmosphere

8912 (BNWL-1880) PACIFIC NORTHWEST LABORATORY MONTHLY ACTIVITIES REPORT, OCTOBER 1974. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1974. Contract AT(45-1)-1830. 18p. Dep. NTIS $4.00.

Studies were conducted on: development of operating control instrumentation for an air filter array used in resuspension studies; characterization of sediment samples as to bulk and particle density, hydraulic conductivity, and fluid retentivity; experiments on potential release of ^{137}Cs during cleaning of surface material; formulation of the surface flux model which incorporates the Gaussian plume model; analysis of soil samples from contaminated U-pond areas; concentrations of airborne ^{137}Cs, ^{95}Zr, ^{95}Nb, and ^{144}Ce at east side of U-pond; well elevation surveys; storage of high-level liquid wastes; background radiation measurements; recalibration of nuclear accident dosimeters; personnel dosimeter studies; and restandardization of the calibration fields to BNS. (HLW)

8913 (COO-1199-50) STUDY OF RAINOUT OF RADIOACTIVITY IN ILLINOIS. Thirteenth Progress Report. Semonin, R. G. (Illinois Univ., Urbana (USA)). Apr 1975. Contract AT(11-1)-1199. 25p. Dep. NTIS $4.25.

The field experiments have been continued to estimate convective storm particulate scavenging efficiency in proximity to the St. Louis, Missouri urban-industrial complex. Complimentary studies of the urban aerosol characterization, source strength, and removal processes were also studied. The 1974 field effort produced the following types of samples for analysis and interpretation: 1440 total rain samples from 80 sites; 150 sequential rainwater samples from 3 locations; 73 wet/dry samples from 8 sites; 146 air filter samples from 8 locations; and 27 air filter samples from aircraft. The analysis procedures require that all water samples undergo filtering for separate analyses of soluble and insoluble fractions of the elemental concentrations. This data collection effort provided 3672 samples for chemical analysis. The status of the analysis of all types of data is described. (HLN)

8914 (ORO-4394-3) WIND EFFECTED REDISTRIBUTION OF SURFACE CONTAMINATION. Progress Report, September 1974–August 1975. Amato, A. J. (Norfolk State Coll., Va. (USA)). 1975. Contract AT(40-1)-4394. 33p. Dep. NTIS $4.75.

Theoretical resuspension ratios were computed through the extension of a one-dimensional model used to simulate the wind effected movement of surface contaminants. The surface movement of contamination associated with inhalable size particles was considered in relation to time, space, wind velocity, distance from the source, soil resuspension ratios, and other variables. A computer program was developed to calculate the wind effected distribution of surface contaminants. (CH)

8915 ANNIHILATION γ-EMISSION IN THE ATMOSPHERIC BOUNDARY LAYER. Ionov, V. A.; Nazarov, I. M. (Inst. of Applied Geophysics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 458-460(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 542(1974).

Many studies have been devoted to the measurement of the intensity of annihilation radiation in the upper layers of the atmo-

sphere, but there is hardly any information on this radiation in the atmospheric boundary layer. Here the intensity distribution of annihilation quanta from the surface to 3500 m above sea level is studied. (W.D.M.)

Soil

Refer also to abstract 8577.

8916 (BNWL-1889) SORPTION OF ^{99}Tc, ^{237}Np AND ^{241}Am ON TWO SUBSOILS FROM DIFFERING WEATHERING INTENSITY AREAS. Routson, R. C.; Jansen, G.; Robinson, A. V. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-1830. 15p. Dep. NTIS $4.00.

For the U. S. Energy Research and Development Administration.

Distribution coefficients (Kd values) were determined on subsoils from Washington and South Carolina for ^{241}Am, ^{237}Np, and ^{99}Tc as a function of equilibrium solution concentration of calcium (Ca^{+2}) and of sodium (Na^{+}). Kd values decreased in all cases with increasing solution concentrations of Ca^{+2} and Na^{+}. For the South Carolina subsoil Kd values ranged from 1.0 to 67 for ^{241}Am as a function of Ca^{+2}, 1.6 to 280 for ^{241}Am as a function of Na^{+}, 0.43 to 0.66 for ^{237}Np as a function of Ca^{+2}, and 0.16 to 0.25 for ^{237}Np as a function of Na^{+}. For the Washington soil Kd values were greater than 1200 for ^{241}Am and ranged from 0.36 to 2.37 as a function of Ca^{+2} and from 3.19 to 3.90 for ^{237}Np as a function of Na^{+}. Kd values for ^{99}Tc were essentially 0 at all $NaHCO_3$ concentrations on the South Carolina subsoil. (auth)

8917 CONVECTIVE DIFFUSION OF STRONTIUM IONS IN QUARTZ SAND. Ryzhinskii, M. V. (Leningrad Agrophysical Research Inst.). Russ. J. Phys. Chem.; 48: No. 9, 1362-1364 (Sep 1974).

Translated from Zh. Fiz. Khim.; 48: No. 9, 2304-2308.

The quasi-diffusion coefficient of Sr^{2+} in quartz sand increases substantially when the flow rate of the eluent is increased from 0 to 0.8×10^{-3} cm s^{-1}. At low velocities of the Sr^{2+} ion ($\sim 10^{-6}$ cm s^{-1})D^* is independent of flow rate, and the diffuseness of the Sr^{2+} band is due entirely to the ionic diffusion of Sr^{2+}. At flow rates of $\sim 10^{-3}$ cm s^{-1} (with distilled water or 0.005 N $CaCl_2$ solution as the eluent) the main contribution to band spreading comes from sorption kinetics. However, with 0.05 and 1 N solutions of $CaCl_2$ as the eluent the process goes effectively to equilibrium, and band spreading arises from ionic diffusion and from the granularity effect. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 9198 and 9258.

8918 (BNWL-1905) EFFECT OF SOIL CONCENTRATION ON THE TUMBLEWEED UPTAKE OF ^{90}Sr AND ^{137}Cs FROM A BURBANK SAND. Routson, R. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1975. Contract AT(45-1)-1830. 14p. Dep. NTIS $4.00.

For the U. S. Energy Research and Development Administration.

Concentration factors (CF values) for tumbleweed shoots have been measured as a function of soil radionuclide concentration and plant age. CF values were constant in totally mixed Burbank sand soil for Sr over five orders of magnitude and for Cs over three orders of magnitude of soil radionuclide concentration. CF values for 8- and 12-week-old plants were 9.6 and 19 for Sr and 0.033 and 0.053 for Cs, respectively. CF values measured in totally mixed and layered systems were compared. (auth)

8919 (BNWL-SA-5346) ECOLOGICAL BEHAVIOR OF PLUTONIUM AND AMERICIUM IN A FRESHWATER POND. Emery, R. M.; Klopfer, D. C.; Garland, T. R.; Weimer, W. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1975. 38p. (CONF-750503-19). Dep. NTIS $5.00.

From 4th national symposium on radioecology; Corvallis, Oregon, USA (12 May 1975).

A Pu processing waste pond on the Hanford Reservation has been studied since mid-1973 to characterize the pond's limnology and determine the ecological behavior in this ecosystem. This shallow 14-acre pond has existed and received Pu processing wastes for about 30 years. During this period about 8.1 kg of Pu was reported to have been discharged into waste trenches leading to the pond. This ultra-eutrophic pond has a water inflow rate of 10 m^3/min, of which greater than 95 percent leaves the pond by percolation. Macrophytes (mainly Potamogeton), algae (mainly Cladophora), benthic invertebrates (mainly dipteran and odonate larvae, hemipterans, amphipods, and gastropods) and goldfish are the major biotic components of the system. Sediments are the principal repository of Pu and Am having mean concentrations for ^{238}Pu, $^{239+240}Pu$, and ^{241}Am of 169, 177, and 81 pCi/g (dry), respectively. Mean ratios of isotopes in the sediments are 0.85 for ^{238}Pu to $^{239+240}Pu$, 0.61 for ^{241}Am to ^{238}Pu, and 0.49 for ^{241}Am to $^{239+240}Pu$. Levels of Pu and Am in the interstitial water range from 0.5 to 13 pCi/g (dry wt. of sediment) and exist mainly in cationic or nonionic forms. For ^{238}Pu in pond water the mean concentration is 0.007 pCi/l, for $^{239+240}Pu$ it is 0.002 pCi/l, and for ^{241}Am it is 1.08 pCi/l. Algal floc (decomposing algal material) is the major concentrator of Pu and Am in the pond having mean concentrations for ^{238}Pu of 986 pCi/g, for $^{239+240}Pu$ of 615 pCi/g, and for ^{241}Am of 256 pCi/g. Watercress (Rorippa) had Pu levels about equal to those of the sediments, while dragonfly larvae (Libellula) and snails (Lymnaea) along with watercress had Am levels approximating those of the sediments. The remaining biota had Pu and Am levels which were generally well below those of the sediments. Although goldfish remain in the pond longer than any of the other fauna, and feed most heavily on plant, algae, and organic debris, they concentrate relatively small amounts of Pu and Am (about 10 to 15 pCi/g). In situ experiments indicate that goldfish reach an equilibrium level for Pu of about 15 pCi/g within a few days of exposure to the pond, after which they may remain active in the pond for many months without further accumulation. The biological availability of ^{238}Pu appeared to be greater than that of $^{239+240}Pu$ since most of the pond organisms sampled accumulated more ^{238}Pu than $^{239+240}Pu$ on an activity basis. Ratios of ^{238}Pu to $^{239+240}Pu$, and ^{241}Am to $^{239+240}Pu$ are significantly higher in the pond biota than in the pond sediments. These results primarily indicate that transuranics are being made available and/or utilized by pond organisms in ratios which are not reflected by pond sediment concentrations. A common source of available Pu and Am for pond biota is suggested by the rapid establishment of ^{238}Pu to $^{239+240}Pu$, and ^{241}Am to $^{239+240}Pu$ ratios in imported goldfish. Within 2 weeks after these fish had been introduced into the pond they had accumulated transuranic ratios which were similar to those of all other pond biota and dissimilar to those of the pond sediment. Ratios of ^{241}Am to ^{238}Pu in U-Pond biota are significantly different from those of the sediments but to a lesser degree than ratios of ^{238}Pu to $^{239+240}Pu$ and ^{241}Am to $^{239+240}Pu$. (auth)

8920 (BNWL-SA-5411) IODINE-129 IN AQUATIC ORGANISMS NEAR NUCLEAR FUELS PROCESSING PLANTS. Watson, D. G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1975. 14p. (CONF-750503-22). Dep. NTIS $4.00.

From 4th national symposium on radioecology; Corvallis, Oregon, USA (12 May 1975).

Concentrations of ^{129}I in two aquatic habitats near nuclear fuel processing plants were highest in algae and crustaceans. These two forms may be useful in future monitoring of ^{129}I. There is some indication of an increase in atom ratios and specific activity in aquatic organisms over that in water and sediments. Additional measurements should be made to verify this conclusion. Efforts should continue to measure the possible long term build-up of ^{129}I in aquatic environments receiving effluents from fuels reprocessing plants. Even at very low rates of release to the environment, the long physical half-life of ^{129}I creates the potential for build-up of this nuclide to significant levels. (auth)

8921 (DP-MS-75-65) RADIONUCLIDE CONTENT OF VEGETATION AND SOIL ON AN INTEGRATED NUCLEAR COMPLEX. Schneider, P. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 6p. Dep. NTIS $4.00.

Samples of soil and vegetation collected at the Savannah River Plant in July 1974 were analyzed for plutonium, using different procedures. The method of choice for soil analysis involved a leach procedure followed by separation using an ion exchange column. The elute was finally adjusted to the proper pH and electroplated to platinum. Counting was done on a solid state alpha spectrometer to resolve ^{236}Pu, ^{238}Pu, and $^{239-240}Pu$. An internal spike of ^{236}Pu is used to calculate percent recovery. The method of plutonium analysis for vegetation involved dissolution of the ashed plant material and then double separation. The first separation was with TIOA-xylene, and the second used HCl. The organic residue was then destroyed using nitric acid and hydrogen peroxide. Finally, the solution was mounted on a planchet and counted in an alpha spectrometer. Data are included on the content of ^{137}Cs and ^{90}Sr in the samples. (CH)

8922 (SRO-642-5) EVALUATION OF THE FACTORS INVOLVED IN BIOACCUMULATION OF GAMMA-EMITTING RADIONUCLIDES IN WHITE-TAILED DEER (ODOCOILEUS VIRGINIANUS). Sixth Technical Progress Report, July 1, 1974–June 30, 1975. Jenkins, J. H. (Georgia Univ., Athens (USA). School of Forest Resources). 1 Apr 1975. Contract AT(38-1)-642. 40p. Dep. NTIS $5.00.

Radioanalysis of 165 deer specimens in 1974 from the Southeast may show the beginning of a decline in radiocesium (^{137}Cs) bioaccumulation. White-tailed deer from Georgia and adjacent states ranged from less than 200 pCi/kg to 42,000 pCi/kg wet weight of muscle. Palmetto Bluff, S. C. deer (near Savannah, Georgia) showed some decline while 15 north Florida deer still averaged

around 16,000 pCi/kg which is nearly three times that reported for 1973 Alaska caribou. Southeastern white-tailed deer continue to yield spectacularly high levels of radiostrontium (^{90}Sr). Although ^{90}Sr levels were lower than the previous year, one sample of 67,000 pCi/kg wet weight of bone was recorded for Echols Co., Georgia, an area which has previously produced ^{90}Sr levels up to 91,000 pCi/kg in white-tails. Extreme variability in radiostrontium burdens in deer suggest that possibly some unique mechanisms are involved in the transfer of ^{90}Sr from the environment to the animals. Vegetation analyses for both ^{90}Sr and ^{137}Cs have also shown a decrease over the past two years. It appears that fluctuations in ^{137}Cs levels in deer are primarily a result of habitat and deer food production changes, which are cyclic over a two to four year period. Only through some continued monitoring of these unique areas can it be determined whether ^{137}Cs and ^{90}Sr are really declining in wild animals. Mercury levels in mammals collected in Georgia, Florida, and South Carolina were compared between physiographic provinces. Georgia specimens were divided into those from the Piedmont, Upper Coastal Plain, and Lower Coastal Plain counties. All Florida animals were considered Lower Coastal Plain specimens. South Carolina specimens were from the Savannah River Plant which is located in the Upper Coastal Plain. Mammals collected on the Savannah River Plant exhibited higher average levels but lower maximums than those from the Lower Coastal Plain. The highest mercury levels detected in individual mammals occurred in raccoons, bobcats, and otter from the Lower Coastal Plain habitats of southern Georgia. A paper giving details of this study is appended to this report. Included in this report is a summary sheet (1954-1974) showing trapline data for the annual furbearer census which was once again conducted at the Savannah River Plant, Aiken, South Carolina in 1974. (auth)

8923 REDUCTION OF ^{90}Sr CONTENT OF SOIL-PLANT COVER OF TUNDRA. Kulikov, N. V.; Molchanova, I. V. (Inst. of Plant and Animal Ecology, Sverdlovsk, USSR). Sov. J. Ecol. (Engl. Transl.); 5: No. 2, 150-151(1974).

Translated from Ekologiya; 5: No. 2, 69-70(1974).

Data are presented on the variations of the ^{90}Sr content of soils and plants of the subarctic tundra during the period from 1966 through 1970. The results indicate that approximately as much ^{90}Sr migrated out of the biogeocenoses as entered the soil from the plant cover. It is possible that ^{90}Sr entering the soil by being washed off plants and by the death and decay of plants cannot be bound in soil with an excessively high moisture content and strong surface runoff and, hence, migrates relatively easily by solution in water. (ERB)

8924 PROBABILITY AND STATISTICAL CHARACTERISTICS OF CONCENTRATION OF RADIONUCLIDES IN FRESHWATER PLANTS. Piskunov, L. I.; Popov, B. V. (Inst. of Plant and Animal Ecology, Sverdlovsk, USSR). Sov. J. Ecol. (Engl. Transl.); 5: No. 3, 276-278(1974).

Translated from Ekologiya; 5: No. 3, 90-93(1974).

The use of hydrobionts as bioindicators of radioactive contamination of waters is a promising line of work in applied radioecology. In this connection it is of theoretical and practical interest to investigate the distribution of radionuclides among the components of a hydrobiocenose. On the basis of radioecological investigations in experimental conditions and in natural waters the probability and statistical characteristics of the radionuclide concentration factors of freshwater plants were studied. The difference of the variation coefficients V of such radionuclides as ^{45}Ca, ^{60}Co, ^{86}Rb, ^{90}Sr, and ^{106}Ru (V_e) from the group ^{59}Fe, ^{65}Zn, ^{91}Y, ^{95}Zr, ^{95}Nb, and ^{137}Cs (V_p) determined by the Wilcoxon criterion, is statistically significant with the probability of error not exceeding 5%. We can postulate that this type of distribution of variation coefficients, when $\overline{V}_e < \overline{V}_p$ on the average, is due to the fact that the first group of radionuclides are equitropes and the second are pedotropes. If this is so, then ^{60}Co should be classed as a pedotrope. At any rate, the distribution of elements according to their preferential concentration in any main component of the water requires more rigorous substantiation. Our analysis enabled us to generalize the available information on the concentration factors of freshwater plants for the main radionuclides in the form of their probability and statistical characteristics. The distributions of the factors are more precisely defined and plants with anomalous nuclide concentration functions are better distinguished. The obtained data can be used to improve radioecological methods in the dosimetric monitoring of surface waters, particularly at the sites of atomic power stations. (ERB)

8925 ON THE REDUCTION OF THE ^{90}Sr CONTENT IN THE SOIL COVER AND VEGETATION IN TUNDRA. Kulikov, N. V.; Molchanova, I. V. (AN SSSR, Sverdlovsk. Inst. Ekhologii Rastenij i Zhivotnykh). Ekologiya; No. 2, 69-70(Mar 1974). (In Russian).

For English translation see the journal Ecology.

Data are presented on the change of Sr-90 content in the soil and plants of the subarctic tundra in the period from 1966 to 1970. The results of the study show that during the period of these studies, primarily only strontium-90 migrated beyond the limits of the biogeocenotic community after entering the soil from the plant cover. It is possible that radionuclides entering the soil from plants as a result of elution or by decay cannot be fixed in the soil under conditions of excess leaching and excessive surface runoff, and hence, migrate relatively easily in aqueous solution. (tr-INIS)

Radiometric Techniques

Refer also to abstracts 8445, 8460–8461, 8463, and 8902.

8926 (GSF-R-97) ANNUAL REPORT 1973. Moser, H.; Neumaier, F.; Batsche, H.; Behrens, H.; Bergmann, H.; Drost, W.; Hefka, R.; Klotz, D.; Rauert, W.; Seiler, K. P. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Radiohydrometrie). Aug 1974. 180p. (In German). INIS.

With figs., tabs. and refs. With app.

A report is given on 1) laboratory investigations to measure groundwater flow, on the measurements of the tritium and carbon-14 content of water samples, of deuterium, oxygen-18 and carbon-13 content in natural waters, on apparative development work, on 2) ground tests of the groundwater flow, of the isotope content in groundwater, hammer seismology of the Murnauer und Eschenloher moss, the hydrology of the groundwater resevoir in the Alps border Zone, at Asse, of surface waters, of the detection of iodine-131 in the deposit as well as on the publications and lectures of the institute. (GE)

8927 (INIS-mf-1687) STUDY OF SEDIMENT TRANSPORT ON THE SEA BED AND ON THE BEACH AT THE SITE OF THE HADERA POWER PLANT. Report to the Israel Electric Corporation. Sauzay, G.; Gilath, Ch.; Meltzer, M.; Courtois, G.; Frenkel, I.; Levin, A.; Blit, S. (Israel Atomic Energy Commission, Tel Aviv). 1974. 59p. INIS.

26 figs.

The Israel Electric Corporation had undertaken a series of measurements at the site of the new power plant at Hadera. Experiments with tracers were performed in order to find the direction and extent of sand transport as a function of the depth and different hydrodynamic conditions. Radioactive tracers were used for measurements on the sea bed while fluorescent tracers were used on the beach. The purpose of the present report is to give a more detailed account on the experiments performed with radioactive and fluorescent tracers. (auth)

8928 ISOTOPE EFFECTS IN METEOROLOGY. Opauszky, I.; Matus, L.; Nyari, I. (MTA Kosponti Fiziki Kutato Intezete, Budapest). Izotoptechnika.; 18: No. 3, 146-157(Mar 1975). (In Hungarian).

The isotopic ratio $^{18}O/^{16}O$ and conditions of precipitation formation are given. This ratio shows the so-called seasonal variation, which emphasizes the Atlantic Ocean orientation of the weather in the Carpathian Basin. These data are the first from this geographical region. (auth)

8929 ANNEALING CHARACTERISTICS OF INDUCED FISSION TRACKS IN MICACEOUS MINERALS. Virk, H. S.; Koul, S. L. (Punjab Univ., Patiala, India). Curr. Sci. (India); 44: No. 10, 341-342(20 May 1975).

Annealing effects were observed at laboratory temperatures in micaceous minerals of the Kodarma zone, Bihar mica belt. The track fading can be caused by a short-time, high-temperature event or by a long-time anneal at a slightly elevated temperature during the geothermal history of the earth's crust. The annealing temperature for muscovite is 700°C and for biotite it is 500°C. (MCG)

8930 ISOTOPE GEOCHRONOLOGY IN THE INDONESIAN TIN BELT. Priem, H. N. A. (Laboratorium voor Isotopen-Geologie, Amsterdam); Boelrijk, N. A. I. M.; Hebeda, E. H.; Verdurmen, E. A. T.; Verschure, R. H.; Bon, E. H. Geol. Mijnbouw; 54: No. 1, 61-70(May 1975).

Granitic rocks on Belitung (Billiton), Banka and the Tuju islands (Pulau Tudjuh) have an Rb-Sr isochron age of 217 ± Ma with initial $^{87}Sr/^{86}Sr = 0.7152 \pm 0.0029$ (15 whole-rocks and 4 biotites). K-Ar ages of four hornblendes and two biotites average 214 ± 4 Ma. The granitic complex on Karimata has an Rb-Sr isochron on age of 74 ± 2 Ma with initial $^{87}Sr/^{86}Sr = 0.7101 \pm 0.0025$ (8 whole rocks), while an associated amphibolite has a K-Ar age of 78 ± 5 Ma. (Rb-Sr ages based upon $d = 1.39 \times 10^{-11}/a$; errors at 95% confidence level.) The granites have intruded into flysch-type sediments containing Norian fossils. While the regional stratigraphic and tectonic relationships strongly suggest that they are overlain by fossiliferous sediments of probably Rhaetian age. The age of

217 ± 5 Ma can thus be taken as the minimum age of the Norian, probably as representing the Norian/Rhaetian boundary. Cassiterite mineralisation is associated with both Upper Cretaceous and Upper Triassic granitic masses, but major tin deposits are related only to Upper Triassic plutons. (INIS)

8931 OXYGEN AND SULFUR ISOTOPIC COMPOSITION OF THE SULFATE IONS FROM MINERAL AND THERMAL GROUNDWATERS OF POLAND. Cortecci, G. (Pisa Univ., Italy); Dowgiallo, J. J. Hydrol.; 24: No. 3, 271-282(Feb 1975).

This paper gives the ^{18}O and the ^{34}S contents of the sulfate dissolved in some mineral and thermal groundwaters in northwest Poland, in the Carpathians, in the Carpathian foredeep and in the Sudety Mountains. The oxygen isotopic composition of sulfate ions is compared with the $^{18}O/^{16}O$ and D/H ratios of the environmental waters. From the results obtained, the oxygen and sulfur isotopic composition of the sulfate ions seems generally due to a sulfate bacterial metabolic activity, which has enriched the residual sulfate in the heavy isotopes. (INIS)

8932 GEOCHEMISTRY OF STABLE ISOTOPES. Hoefs, J. (Univ., Gottingen, Ger.). Angew. Chem. Int. Ed. Engl.; 14: No. 2, 75-79(Feb 1975).

Natural variations in isotopic composition arising by processes attributable to differing zero mass energies of the isotopes and thus to their differing masses are discussed. Topics covered include: isotope fractionation, water, thermometry, biosphere, sulfide ore deposits, and extraterrestrial material. (MCG)

8933 PRECAMBRIAN SEDIMENTARY CARBONATES: CARBON AND OXYGEN ISOTOPE GEOCHEMISTRY AND IMPLICATIONS FOR THE TERRESTRIAL OXYGEN BUDGET. Schidlowski, M.; Eichmann, R.; Junge, C. E. (Max-Planck-Institut fuer Chemie, Mainz). Precambrian Res.; 2: No. 1, 1-69(Feb 1975).

Carbon isotope values of 260 Precambrian limestones and dolomites (most of them being substantially unaltered) yielded an overall mean of $\delta^{13}C = +0.4 \pm 2.7‰$ vs. PDB; the corresponding oxygen values average at $\delta^{18}O = +20.0 \pm 4.2‰$ vs. SMOW. Like the overall mean, the $\delta^{13}C$ values furnished by individual carbonate occurrences are, as a rule, fairly "modern" and almost constant as from the very beginning of the sedimentary record. A remarkable exception are the "heavy" dolomites of the Middle Precambrian Lomagundi Group, Rhodesia, with $\delta^{13}C = +9.4 \pm 2.0‰$ vs. PDB. The approximate constancy around zero per mill of the $\delta^{13}C$ values of marine carbonates through geologic time would imply a corresponding constancy of a relative proportion of the organic carbon in the total sedimentary carbon reservoir since about 3.3×10^9 y ago (with $C_{org}/C_{total} \cong 0.2$). Utilizing this ratio and current models for the accumulation of the sedimentary mass as a function of time, a reasonable approximation was obtained for the absolute quantity of organic carbon buried in sediments and, accordingly, of photosynthetic oxygen released. Within the constraints of the model (based on a terrestrial degassing constant $\lambda = 1.16 \times 10^{-9} y^{-1}$) close to 80% of the amount of oxygen contained in the present oxygen budget should have been released prior to 3×10^9 y ago. Since geological evidence indicates an O_2-deficient environment during the Early and most parts of the Middle Precambrian, there is a reason to believe that the distribution of this oxygen between the "bound" and the "molecular" reservoir was different from that of today (with effective O_2-consuming reactions bringing about an instantaneous transfer to the crust of any molecular oxygen released). Accordingly, the amount of C_{org} in the ancient sedimentary reservoir as derived from our isotope data is just a measure of the gross amount of photosynthetic oxygen produced, withholding any information as to how this oxygen was partitioned between the principal reservoirs. As a whole, the carbon isotope data accrued provide evidence of an extremely early origin of life on Earth since the impact of organic carbon on the geochemical carbon cycle can be traced back to almost 3.5×10^9 y. (NL)

8934 EVOLUTION OF PRECAMBRIAN CRUST FROM STRONTIUM ISOTOPIC EVIDENCE. Moorbath, S. (Oxford Univ.). Nature (London).; 254: No. 5499, 395-398(3 Apr 1975).

It is stated that strontium isotope evidence places constraints on the evolution of Precambrian crust. Contrary to popular belief, sialic crust cannot, it seems, be reworked on a grand scale. (auth)

8935 $^{214}Bi/^{214}Pb$ RATIOS IN AIR AT A HEIGHT OF 20 m. Shapiro, M.H.; Forbes-Resha, J.L. (Department of Physics, California State University, Fullerton, Fullerton, California 92634). J. Geophys. Res. 80: No. 12, 1605-1613 (20 Apr 1975).

High-resolution gamma ray spectroscopy has been used to obtain ratios of ^{214}Bi to ^{214}Pb specific activities for large volume air samples taken at a height of 20 m. Afternoon samples that were taken for a period of several months exhibited $^{214}Bi/^{214}Pb$ ratios that ranged from 0 to 2.2 with a mean value of 0.67±0.06. Observed ^{214}Pb specific activities for this group of samples ranged from 35.2 to 360.4 pCi/m³ with a mean value of 122.8 pCi/m³. Most samples exhibiting $^{214}Bi/^{214}Pb$ ratios greater than 1.0 were associated both with low values of ^{214}Pb specific activity and with the advection of maritime air during the sampling period. When samples taken during strong winds are excluded, a mean $^{214}Bi/^{214}Pb$ activity ratio of 0.48±0.08 is obtained. A smaller group of morning samples taken at the same location exhibited a mean $^{214}Bi/^{214}Pb$ ratio of 0.70±0.08. The results of these measurements have been compared with the predictions of turbulent diffusion theory. (auth)

8936 TRACER DIFFUSION OF TRITIATED WATER (THO) IN ORDINARY WATER (H_2O) UNDER PRESSURE. Woolf, L. A. (Australian National Univ., Canberra). J. Chem. Soc. (London), Faraday Trans., I.; 71: No. 4, 784-796(1975).

The tracer diffusion coefficient of THO in H_2O has been measured at temperatures between 277 and 318 K for pressures up to about 2.2 kbar. Duplicate results were reproducible to ±0.8% or better. Up to about 308 K the diffusion coefficients show an initial increase with pressure to a broad maximum. They are discussed with reference to a partial correlation with the anomalous pressure dependence of the shear viscosity of water, a distorted hydrogen-bond model of water, and a modified hard sphere theory of transport in fluids. (auth)

8937 GEOKHIMIYA RADIOGENNYKH I RADIOAKTIVNYKH IZOTOPOV. (Geochemistry of radiogenic and radioactive isotopes). Gerling, E. K.; Shukolyukov, Yu. A. (eds.). Leningrad; Izdatel'stvo Nauka (1974). 256p.

Papers are presented on the quantitative propagation and distribution of isotopes of He, Ar, Li, Ne, K, Rb, Sr, and Ra in different natural objects are compiled. Separate abstracts were prepared for 15 of the papers. (JSR)

For abstracts of individual papers see: 8460–8463, and 8938–8948.

8938 GEOCHEMISTRY OF NEON ISOTOPES. Shukolyukov, Yu. A.; Ashkinadze, G. Sh.; Verkhovskii, A. B.; Sharif-Zade, V. B. pp 5-45 of Geokhimiya radioennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian).

All contemporary data on the geochemistry of neon isotopes was generalized. It was shown that soil neon is a mixture of several components of different origin: solar, planetary, and radiogenic. Variations of the isotopic composition of Ne in minerals attain several hundred percent. In natural gases the ratio of Ne isotopes changes as a function of the origin of the gas. A strong fractionation of Ne isotopes was observed during its migration from crystalline structures to the gaseous phase. Isotopic anomalies of Ne can be used both during the study of theoretical problems of the evolution of the materials of the earth and for the solution of practical prospecting problems. (tr-auth)

8939 MASS-SPECTRAL THERMAL ANALYSIS OF ROCK-FORMING MINERALS (ARGON MEASUREMENTS). Morozova, I. M.; Shurkina, L. K.; Sprintsson, V. D. pp 46-67 of Geokhimiya radioennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

Results on the Ar measurements of biotites were systematized. A comparative study was made by argon measurements of unchanged and thermally altered biotites and biotites altered by chemical changes. The character of the argon measurements of the biotite was proposed as a criterion for the reliability of K-Ar age evaluations. (tr-auth)

8940 ISOTOPES OF HELIUM, NEON, AND ARGON IN TROILITE AND SHREIBERSITE INCLUSIONS OF SITKOTE-ALIN METEORITE. Levskii, L. K.; Komarov, A. N. pp 67-79 of Geokhimiya radioennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

The isotopic composition and He, Ne, and Ar content were studied by stepwise annealing. The $^4He/^3He$ ratio in troilites from different fragments of the meteorite varied from 6.90 to 30.5. This same ratio for the metallic phases varies from 4.00 to 4.65. The absolute content of excess ^4He is 560 to 1050×10^{-8} cc STR/g. The U concentration in the troilites, measured from the fission fragment tracks, is equal to 0.9×10^{-9} (for the interior part of the troilite crystal) and 1.4×10^{-9} g/g (for the external part). The results of the stepwise annealing are inconsistent with the possibility of the primary origin of excess ^4He. A radiogenic origin for the excess is the most probable explanation. Under some assumption the absolute age of the troilites can be 5.9×10^9 years. The results on the study of spallogenic isotopes Ar, Ne, and He differ from accelerator-obtained data. (tr-auth)

8941 EVALUATION OF THE HELIUM DIFFUSION COEFFICIENT IN CRYSTALLINE QUARTZ. Tolstikhin, I. N.; Prasolov, E. M.; Khabarli, L. V.; Azbel, I. Ya,. pp 79-90 of Geokhimiya radioennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

A method was proposed for the determination of the He diffusion coefficient in natural quartz crystals. It is based on the experimentally established differences in the isotopic ratio $^3He/^4He$ in crystalline lattice and in microinclusions. For the sample of honeycomb quartz studied, for example, the value of the helium diffusion coefficient was measured as $D \approx 10^{-19}$ cm²/sec. (tr-auth)

8942 DIFFUSION OF ISOTOPES OF LITHIUM AND POTASSIUM IN NATURAL ALUMOSILICATES. Morozova, I. M.; Alferovskii, A. A.; Yakovleva, S. Z. pp 105-130 of Geokhimiya radioennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

The isotopic composition of Li and K in natural alumosilicates during their diffusion introduction, escape, and mass exchange through the boundaries of two media was studied. For study of the isotopic composition the method of thermionic emission was used. The isotopic displacement detected did not exceed 5% for the mean-square error of reproducibility of < 0.5 for Li and < 1% for K. (tr-auth)

8943 RADIOBARYTA AS A NATURAL INDICATOR OF MIGRATING RADIUM. Komarov, A. N. pp 131-138 of Geokhimiya radioennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

Radiobarytes with a high Ra content were detected in ores of U deposits and studied by alpha microradiography. It was established that Ra is found on the surface of crystals and grains of hypogenic barytes. The incorporation of Ra in the crystalline structure of the mineral occurs, probably, as the results of adsorption processes at the surface layers. The Ra content on the surface of radiobarytes was 6.3×10^{-8} g/cm² from the microradiographic data was 0.088 wt.% for the small grains found, which is the highest value for natural formations containing Ra. Hypogenic barytes, under given geochemical conditions, can be considered as a sensitive natural indicator of migrating Ra. (tr-auth)

8944 POTASSIUM AND RUBIDIUM IN THE OLDEST ROCKS OF THE MONCHETUNDRA COMPLEX OF THE KOLA PENINSULA. Yakovleva, S. Z.; Sharkov, E. V. pp 139-162 of Geokhimiya radiogennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

The abundance of K and Rb in basic and ultrabasic rocks of the Monchetundra complex was studied. The K content varies from 0.009 to 0.315% and that of Rb from 0.4 to 8.8 γ/g. Two groups of K/Rb ratios were found: one with a maximum value of 300 to 400 was coordinated with the lower gabbronorite part of the cross section and the other with a maximum value of 600 to 800 was characteristic of the upper gabbrolabradorite part of the cross section. Possible cause for the variations found in the K/Rb ratio were examined. It was proposed that the change of the K/Rb ratio was caused by the variable mineralogy of the samples examined and the appearance of high K/Rb ratios was related to the discrimination of Rb by plagioclase. (tr-auth)

8945 VARIATION OF THE K/Rb RATIO IN BASIC ROCKS FROM DIFFERENT GEOTECTONIC RANGES. Yakovleva, S. Z. pp 163-175 of Geokhimiya radiogennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

The K/Rb ratio in uniform rocks of the traprock in the Siberian platform and basic effusions of the Pecheng series were compared. In spite of the fact that the rocks studies were characterized by similar concentrations of K and Rb, the variation of the K/Rb ratio in effusions of Pecheng was more significant than in the rocks of the Siberian platform. Probably this is caused by the different geotectonic circumstances for the formation of the basic effusions. (tr-auth)

8946 VARIATION OF THE $^{87}Sr/^{86}Sr$ RATIO IN PROCESSES OF CREATION AND EVOLUTION OF BASALT MAGMA. Varshavskaya, E. S.; Gorokhov, I. M. pp 176-192 of Geokhimiya radiogennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

The factors affecting the isotopic composition of Sr in basalt magma in the process of its formation and evolution are analyzed. On the basis of literature data models were given for the formation of basalt magma (from the viewpoint of the variation of the Sr isotopic ratio). The heterogeneity in the upper mantle of the $^{87}Sr/^{86}Sr$ ratio was indicated. Two reasons for the variation in the $^{87}Sr/^{86}Sr$ ratio in the process of development of the basalt magma were examined. The first is the different contaminations (assimilation of the sialic rocks, selective contamination, and migration of radiogenic Sr). The second is the accumulation of radiogenic Sr in differentiated magmatic sources. (tr-auth)

8947 BEHAVIOR OF RUBIDIUM AND STRONTIUM DURING PROCESSES OF REGIONAL METAMORPHISM AND ULTRAMETAMORPHISM. Krylov, I. N.; Lobach-Zhuchenko, S. B. pp 192-207 of Geokhimiya radiogennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

The geochemistry of Rb and Sr during progressive regional metamorphism (in North Priladozh and North Baikal highlands) and during high-temperature diaphtoresis (in south-west Priladozh and the Baltic shield). About 500 quantitative determinations of the Rb and Sr concentration in rocks were made with the x-ray spectral method. It was shown that the progressive regional metamorphism and the ultramorphism accompanying it occur under conditions of systems closed with respect to these elements, whereas during high-temperature diaphtoresis introduction of Rb and Sr occurs. (tr-auth)

8948 USE OF X-RAY SPECTRAL METHODS FOR THE DETERMINATION OF Rb AND Sr IN ROCKS. Krylov, I. N. pp 207-214 of Geokhimiya radiogennykh i radioaktivnykh izotopov. Gerling, E. K. (ed.). Leningrad; Izdatel'stvo Nauka (1974). (In Russian)

Methodical questions on the determination of small concentrations of Rb and Sr and of the Rb/Sr ratio in rocks, used in Rb-Sr geochronology, are examined. A description is given of the method for the introduction of corrections on the background intensity and on the actual composition of the sample analyzed. An evaluation of the accuracy of the results obtained was made on 19 samples previously analyzed by the isotopic dilution method. (tr-auth)

8949 ASSESSMENT OF IRRADIATION PARAMETERS FOR $^{40}Ar/^{39}Ar$ AGE DETERMINATIONS IN HIFAR REACTOR, AUSTRALIA. Mateen, A.; Green, D. C. (Univ. of Queensland, St. Lucia, Australia). Proc. Roy. Soc. Queensl.; 85: No. 8, 85-93 (1974).

Total fusion $^{40}Ar/^{39}Ar$ ages have been determined on 31 samples of muscovite, biotite, amphiboles, sanidine, and basalt. Conventional K-Ar ages have been determined on 13 of the samples and the remainder have ages which are relatively well known on geological grounds. Ages obtained by the two methods are comparable; in only two cases is the discrepancy outside the limits of experimental error. Irradiation parameters are suggested for the HIFAR reactor in order to obtain optimum results and to minimize interference from neutron interactions with ^{40}K and ^{40}Ca. The problem of neutron flux gradient is largely overcome by coaxial packing of samples and standards in three layers. Correction factors for the Ca- and K-induced interference in HIFAR as determined on pure CaF_2 and K_2SO_4 are: $(^{39}Ar/^{37}Ar)Ca = 8.46 \pm 0.07 \times 10^{-4}$; $(^{36}Ar/^{37}Ar)Ca = 2.76 \pm 0.12 \times 10^{-4}$ and $(^{40}Ar/^{39}Ar)K = 0.28 \pm 0.006$. (auth)

8950 RADIOISOTOPE ASSAY FOR THE QUANTIFICATION OF SULFATE-REDUCING BACTERIA IN SEDIMENT AND WATER. Sand, M. D.; LaRock, P. A.; Hodson, R. E. (Florida State Univ., Tallahassee). Appl. Microbiol.; 29: No. 5, 626-634(May 1975).

A radioisotope enrichment culture method was developed to estimate the physiologically active component of a population of sulfate-reducing bacteria in environmental water and sediment samples. Aliquots of water or sediment were added to 50-ml serum bottles filled with ^{35}S-sulfate broth incubated for approximately 30 h. After incubation, the disintegration rate per milliliter of spent medium was measured, and the percentage of loss of activity resulting from bacterial sulfate reduction was determined. This loss of sulfate from the medium was then translated to a specific number of Desulfovibrio desulfuricans cells that would reduce an equivalent amount of sulfate in the same incubation time. This comparison was done using a series of growth curves of D. desulfuricans covering a range of inoculum densities between 10^2 and 10^7 cells. The radioassay was used to follow the effects of a pulp mill on a small anoxic river in Florida. The activity of the sulfate-reducing bacteria in the river was greatly suppressed when the mill was closed for annual maintenance. The initiation of waste treatment resulted in improved water quality in 1 week, but the river sediments required a month to show a 10-fold reduction in the population of sulfate-reducing bacteria. (auth)

8951 STUDIES ON THE MOVEMENT OF WATER IN PARTIALLY SATURATED SOILS--TRITIUM-TRACER METHOD TO DETERMINE THE CHARGE OF GROUND WATER. Jakubick, A. Heidelberg; Univ. Heidelberg (1972). 53p. (In German). INIS. Thesis.

Tracer experiments were achieved to study the water movement in the layers of partially saturated soils by laboratory and field experiments. In homogeneous sand soils a stratified water transport occurs in saturated as well as in partially saturated state even at extremely high rain intensities. The tracer dispersion there with was almost exclusively of a mechanical nature. In the field-tracer experiments the water household of a sand resp. loam soil nearby to Heidelberg was determined. (GE)

8952 A CONTRIBUTION TO A REVISION OF THE ^{14}C-METHOD FOR MEASURING THE PRIMARY PRODUCTION IN

INLAND WATERS. Lenarz, H. H. Freiburg i.B.; Univ. Freiburg i. B. (1972). 83p. (In German). INIS.

Sources of errors in the ^{14}C method by Steeman–Nielsen for measuring the photosynthetic C-fixation were studied, and comparative measurements were achieved with the decrease of inorganic carbon in the solution of algae cultures and with the oxygen method by Gaarder and Gran. (GE)

Site Surveys

Refer also to abstracts 8921 and 8927.

8953 (ERDA-12) OCEANOGRAPHIC RESEARCH PROGRAM FOR THE CONTINENTAL SHELF OFF THE SOUTHEASTERN UNITED STATES. Proceedings of the Workshop, Aiken, South Carolina, October 8–9, 1974. Blanton, J. O. (ed.). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Biomedical and Environmental Research). 1974. 35p. Dep. NTIS $4.00.

Research programs in the following areas are discussed: physical oceanography; sediment transport; geochemical transport; and biological oceanography. The objective is a better understanding of the ocean system over the continental shelf south of Cape Hatteras in order to estimate the potential impact of nuclear power plants and other energy-related activities located on the continental shelf. (HLW)

8954 (HEDL-TME-75-13) 300 AREA SITE DESCRIPTION. Paglieri, J. N. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Feb 1975. Contract AT(45-1)-2170. 58p. AT.

The 300 Area comprises about 400 acres of the southeast corner of the Federally owned Hanford Reservation, about one mile north of the city limit of Richland, Washington. Research and development laboratories and the fuel fabrication facility for the N Reactor are located in this area. Site characteristics that are pertinent to safety evaluation of nuclear activities in the 300 Area are summarized. Data are included on land use and hydrology, geology, meteorology, and seismology of the site. (CH)

8955 (IA-1299) THE OFFSHORE BARS AT ASHDOD, THEIR TOPOGRAPHY AND SEASONAL BEHAVIOR, AND THEIR INDICATIVE RATIOS. Striem, H. L. (Israel Atomic Energy Commission, Tel Aviv). Jul 1974. 34p. INIS.

4 figs.; 9 tables; 49 refs.

In planning coastal installations, such as those needed to regulate the intake and discharge of cooling water for a nuclear power plant, the topography and behavior of the offshore bars should be considered. Along Israel's sandy southern Mediterranean coast there is usually one main offshore submarine bar. It was found that the bars are not monotonous ridges, but recurrent structures of a significant topography: broad and shallow parts lying nearest the shore, and narrowing branches increasing in depth and distance from the shore. The broad trunk sections are linked to the inshore by a regularly recurring submarine spur or a saddle structure. The trough, separating the bar from the inshore, widens from the trunk onwards as the bar's branch narrows, and enlarges into a deep basin near the sill, the deepest and narrowest section of the bar ridge. The bars usually have skew profiles, reflecting their seasonal movement. During summer and under low waves the bars approach the shore due to a drift-like sediment movement, and they recede seawards after severe storms, as occur during winter, due to a return flow across the bar. The topographic structure interacts with the local flow pattern, the trough channelling the longshore flow which is discharged seawards over the sill as a rip current. It was also found that the ratios between certain bar parameters are indicative of the geomorphic condition of the bar. Thus the ratio of the depth of the trough to the depth of the crest may reach and exceed 1.7 when the first winter storms arrest the shoreward movement of sediment. The ratio drops to 1.2 when the bar has been flattened seawards. The ratio of the distance of the crest from the shore to the depth of the crest is also indicative, reaching 80 and more at winter's end and decreasing to about 55 during the summer when the bar approaches the shore. (auth)

8956 (PRNC-181) TORTUGUERO BAY [PUERTO RICO] ENVIRONMENTAL STUDIES. Wood, E. D.; Youngbluth, M. J.; Nutt, M. E.; Yoshioka, P.; Canoy, M. J. (Puerto Rico Nuclear Center, Mayaguez). 1 Apr 1975. 231p. Dep. NTIS $14.75.

For Puerto Rico Water Resources Authority.

Site selection surveys and environmental research studies of seven coastal sites in Puerto Rico for construction of power generating facilities were carried out. Data are presented on the physical, chemical, and geological parameters of the Tortuguero Bay site, and the ecological parameters of zooplankton, benthic invertebrates, plant, and fish communities. (auth)

8957 (TID-26813) SOIL BEHAVIOR UNDER EARTHQUAKE LOADING CONDITIONS. In Situ Impulse Test for Determination of Shear Modulus for Seismic Response Analyses. Progress Report. (Shannon and Wilson, Inc., Seattle, Wash. (USA); Agbabian Associates, El Segundo, Calif. (USA)). Jun 1974. Contract AT(04-3)-954. 213p. Dep. NTIS $13.75.

Progress is reported in the determination of the best methods of evaluation and prediction of soil behavior of potential nuclear power plant sites under seismic loading conditions. Results are reported of combined experimental and analytical studies undertaken to continue development of an in situ impulse test for determination of the soil shear modulus. Emphasis of the field work was directed toward making the field measurements at frequent depth intervals and at shear strains in the strong motion earthquake range. Emphasis of the analytical work was aimed toward supporting the field effort through processing and evaluation of the experimental test results combined with additional calculations required to gain insight into data interpretation and the in situ test setup itself. Continuing studies to evaluate free field soil behavior under earthquake loading conditions are discussed. (auth)

8958 (USGS-474-215) QUALITY OF WATER IN AQUIFERS OF THE AMARGOSA DESERT AND VICINITY, NEVADA. Robinson, B. P.; Beetem, W. A. (Geological Survey, Denver, Colo. (USA)). 1975. 68p. (NTS-123) Dep. NTIS $5.45.

The U. S. Geological Survey has interpreted the rate and direction of ground-water movement away from the Nevada Test Site by using hydrologic data including results of hydraulic tests and geophysical surveys in deep wells. Ground water from different source areas will have different concentrations of chemical constitutents. Comparison of chemical quality of samples of water from the Amargosa Desert, an area of discharge of ground water moving generally southward from the Nevada Test Site, should provide a better understanding of the nature of the movement. This compilation of analytical data resulting from an intensive sampling program is preliminary to and provides a basis for comparative studies. (auth)

Thermal Effluents

Refer also to abstract 8955.

8959 (EPA-660/2-73-001) PLUME TEMPERATURE MEASUREMENTS OF SHALLOW, SUBMERGED MODEL DISCHARGES WITH CURRENT. Winiarski, L.; Chasse, J. (National Environmental Research Center, Corvallis, Oreg. (USA)). Jan 1973. 60p. EPA, Washington, DC 20460.

Laboratory studies were conducted with a shallow-submerged thermal discharge model in a flowing ambient stream. Plume behavior, characterized by excess temperature, trajectory, and width, was observed to determine the qualitative effects of the discharge angle, Froude number, relative stream velocity, and turbulence in the ambient water. Increasing the angle of discharge in a vertical plane parallel to the direction of stream flow, caused increased dilution and lower temperatures along the trajectory. Jets of higher Froude number diluted less than those of lower Froude number for the same discharge angle and relative stream velocity. With no turbulence in the ambient stream, dilution was increased by a reduction in the ambient stream velocity. However, in a turbulent stream, dilution was decreased by a reduction in the ambient velocity. (auth)

8960 (ORNL-tr-2783) FORMATION AND STABILITY OF RAPIDLY CHANGING STRATA IN MOSHKOVICH BAY OF THE IVANKOVO RESERVOIR. Litvinov, A. S. Translated by Helen S. Warren from Biol. Vnutr. Vod, Inform. Byull.; No. 18, 49–53 (1973). 5p. Dep. NTIS $4.00.

Stratification of the current following hydraulic and thermal interactions of the circulating discharge from the Konakovo Thermal Electric Power Station is described. The disbursement of heated waters, the morphological nature of the region of the water discharge, and the construction of the water discharge installation are discussed. Stratification at various seasons is described. (HLW)

8961 (ORNL-TR-2885) EFFECT OF THERMAL POWER PLANTS ON THE HYDROBIOLOGY OF WATER RESERVOIRS. Proceedings of the Second Symposium, Borok, USSR August 26–28, 1974. Mordukhai–Boltovskoi, F. D. (ed.). 1974. Translated from Russian. (CONF-740856-). 221p. Dep. NTIS $14.25.

Summaries are presented of the papers included in the program of the second Soviet symposium on the effect of thermal and nuclear power plants (TPP and NPP) on the ecosystems of the water reservoirs which are used as cooling systems. The proceedings included represent essentially the results of Soviet studies performed in the last three years. The papers show that the greatest number of studies (half of the papers) concerned

the effect of TPP and NPP on the fauna of the water reservoirs, particularly aquatic invertebrates. Approximately one fourth of the studies was performed on the hydrological and hydrochemical conditions of reservoirs, including pollutants. The remaining fourth of the papers discuss the general problems, and only about 10% (less than 15%) concerned microphytes and macrophytes. Therefore, various aspects of the conditions and life in the cooling ponds have not been studied uniformly; the effects of TPP and NPP on higher plants and microbiological processes were studied very little; consequently, these problems should be given particular attention in the future. Problems of the utilization of the discharged or heated water were not included. (CH)

8962 (ORO-4493-2) ECOLOGICAL STUDY OF THE EFFECTS OF NUCLEAR POWER PLANTS ON BENTHIC MACROPLANT MICROCOSMS IN SUBTROPICAL AND TROPICAL ESTUARIES. Annual Progress Report, 1974–1975. Thorhaug, A. (Miami Univ., Fla. (USA)). May 1975. Contract AT(40-1)-4493. 10p. Dep. NTIS $4.00.

Progress is reported on the following research projects: the dynamic ecology of Thalassia and studies of the Thalassia community; basic ecology of Thalassia growth and reproduction; red macroalgal ecology; green macroalgal ecology; transplantation of Thalassia; succession in a previously damaged Thalassia community at Turkey Point; and thermal ecology of the Thalassia community of Card Sound and Turkey Point. (HLW)

8963 (TID-26692) ECOLOGY OF ANURAN POPULATIONS INHABITING THERMALLY STRESSED AQUATIC ECOSYSTEMS, WITH EMPHASIS ON LARVAL RANA PIPIENS AND BUFO TERRESTRIS. Nelson, D. H. (Michigan State Univ., East Lansing (USA)). 1974. 190p. Dep. NTIS $12.50.

Thesis.

Field and laboratory studies were conducted to determine the responses of anuran populations to thermally stressed aquatic ecosystems. Adult and larval amphibians were sampled in and around a cool arm of a 67 ha reservoir that receives high temperature effluent from a nuclear production reactor on the Savannah River Plant (SRP) in South Carolina. Adult amphibians were sampled in a mark-release program over a 13-month period by pitfall traps placed peripheral to the reservoir. Species diversity, relative abundance, seasonal occurrence and activity patterns were compared among dominant anurans inhabiting the area. These patterns for some species were compared with data from nearby unheated areas and analyzed in terms of the thermal gradient (16–45 C) extending the length of the reservoir's cool arm. Larval amphibians were routinely sampled for 15 successive months by dipnets and minnow traps from two stations in the heated reservoir and from five cool seepage ponds flanking the reservoir. All specimens were identified, and larval Rana pipiens and Bufo terrestris were measured for length and staged according to the level of development. Although larvae of five anuran species were removed from heated reservoir waters, abundance, species diversity and population density were inversely related to the degree of thermal loading sustained. Having the shortest developmental period, B. terrestris was most successful, although restricted to a single breeding migration yearly. Embryonic and larval mortality in some hot areas exceeded 90 percent. Within the limits of thermal tolerance, however, growth of larval R. pipiens and B. terrestris were both inversely related to temperature and directly related to periods of development. Although all embryonic R. pipiens maintained in the laboratory at 35°C died within nine days, most specimens at 30, 25, and 20°C completed development through transformation. Corroborating field data, specimens reared at higher temperatures (30 or 25°C) demonstrated reduced growth rates but increased developmental rates when compared to larvae reared at 20°C. Localized cool stream seepage creates isolated microenvironments that allow for marginal development of the most common anurans (R. pipiens and B. terrestris) in a reservoir receiving supralethal levels of thermal loading (greater than 50°C). The adaptation to breeding during nocturnal rainfall fortuitously confers a double advantage especially to anurans breeding in thermally stressed waters. Both field and laboratory studies confirm that temperatures maintained in excess of 34°C are lethal to eggs, embryos, and larvae of most anurans. Within tolerance limits, increased temperatures reduce growth rates but increase development rates. Although temperature responses must be interpreted at sensitive developmental stages for each species, certain generalities of growth and development apparently hold true within the range of thermal tolerance. It is clear that local physical microhabitats can be altered or effluent temperatures regulated in order to guarantee marginal survival of dominant aquatic populations, and thereby safeguard the stability of the stressed community. (auth)

8964 NUCLEAR POWER PLANTS AND ENVIRONMENTAL PROTECTION. Eckbo, J. K. (Industrikonsult A/S, Oslo). Tek. Ukebl.; 122: No. 16, 15–16(10 Apr 1975). (In Norwegian).

It is first pointed out that while the problems connected with cooling water releases from nuclear and other thermal power plants are mainly assumed to be of a thermal nature, these effluents also include chemical substances added to the cooling water to inhibit algae growth and possibly also to inhibit corrosion. The release of warm water into an aquatic ecosystem will always lead to changes, and it must be assumed that such influences are negative. It is therefore necessary to reduce their consequences. Cooling towers avoid the thermal pollution of surface waters, but the more efficient and cheaper wet towers can lead to mist formation. Cooling ponds may be used to allow the cooling water to be cooled before being released to river, lake, or sea. The mixing properties of the heat sink, due to e.g. tidal currents are important in dissipating the thermal discharges. Public opposition to nuclear power plants' negative environmental effects has led to the planning of offshore power plants, of which four have been ordered in New Jersey. While these represent an attractive solution regarding thermal pollution, other safety hazard aspects may be less satisfactory. (NO)

8965 ECOLOGICAL STUDIES OF NERITIC PHYTOPLANKTON OF SOUTHERN CALIFORNIA: SEASONAL VARIATIONS, ASSOCIATIONS, AND RESPONSES TO TEMPERATURE ELEVATIONS. Briand, F. J. P. Irvine, CA; Univ. of California (1974). 146p. University Microfilms Order No. 75-11,009.

Thesis (Ph. D.).

The first part of this study investigates the seasonal variations and associations of the nearshore phytoplankton communities at Seal Beach, Orange County, California. A total of 90 species was recorded in samples taken weekly from June 1972 to May 1973. On a yearly basis, the two dominant algal groups were diatoms (46 species) and dinoflagellates (36 species), accounting respectively for 64.1 percent and 30.4 percent of the total cell number, and for 20.2 percent and 79.2 percent of the total cell volume. The average phytoplankton concentration throughout the year was 180,000 cells/l. A dinoflagellate bloom was observed in August between the two major peaks of diatoms, which occurred during June–July and in late September. The five most common species Rhizosolenia delicatula, Chaetoceros curvisetus, Prorocentrum micans, Ceratium furca and Gymnodinium simplex were present in more than 50 percent of the samples. The species diversity index (H') remained relatively stable during the year, showing no distinct seasonal pattern. Three interconnected associations of species were distinguished by chi-square analysis. The major group, composed mainly of dinoflagellates, was correlated with warm water conditions at Seal Beach. At this location, two electric power plants use sea-water for cooling purposes at the rate of six million l/min, which subjects the planktonic organisms entrained in the condenser systems to appreciable temperature increases. This problem is general in southern California, where 14 coastal power plants draw presently no less than 20 billion l/day from the ocean. The remainder of this study examined the responses of coastal phytoplankton to temperature increases experienced in the field at Seal Beach (Part II) and in the laboratory (Part III). The large quantities of marine phytoplankton passing through the cooling systems of the two power plants studied were found greatly reduced in numbers (41.7 percent) and in volume (33.7 percent). The biomass killed from June 1972 to May 1973 amounted to approximately 1,700 t of organic carbon. Phytoplankton mortalities were most pronounced from October to December when intake waters of 17 to 20°C were subjected to temperature elevations of 9 to 11°C, and were lowest from January to March when cooler ambient temperatures prevailed. There was no apparent reduction in phytoplankton stocks when the intake water was cooler than 15°C. Passage through the condenser tubes killed greater numbers of diatoms (45.7 percent) than dinoflagellates (32.8 percent), and reinforced the dominance of the two major species Asterionella japonica and Gonyaulax polyedra, which were the most tolerant. Species diversity (H') in the effluent was consistently lower than in the influent. Temperature elevations up to 10°C increased the gross primary productivity by 37 percent when intake water temperatures were 19°C or cooler, and reduced productivity by 22 percent when ambient water temperatures were warmer than 21.5°C. It is suggested that both ambient temperature and extent of heating interact to control phytoplankton mortality at operating power plants. This hypothesis was supported by laboratory studies, where continuous cultures of coastal phytoplankton communities using natural sea-water for medium were allowed to reach equilibrium in cell number and volume and then heated. Temperature elevations of 5°, 10°, and 15°C reduced the number of species by 18 percent, 33 percent, and 72 percent respectively. A 5°C rise enhanced generally both growth rate (in terms of doublings/day) and biomass (in terms of volume), indicating that most phytoplankton species were growing in the field at suboptimal temperatures. Greater temperature elevations resulted in a reduction of phytoplankton volume, which was proportional to the magnitude of

the temperature rise and was significantly more pronounced when applied to warmer waters. Phytoplankton division rates were reduced similarly by a 15°C increment, but were increased by as much as 51 percent and 60 percent when 18°C ambient water was heated 10° and 5° respectively. The experimental effects of heating appear less severe than the direct effects of entrainment through cooling systems. This suggests that the high phytoplankton mortalities encountered at operating power plants are attributable to synergistic effects between temperature, mechanical agitation, and chlorine, which increase the sensitivity of most species to heating. Since heating was consistently less damaging when applied to relatively cold water, use by coastal power plants of deep sea-water for cooling is strongly advocated. (Diss. Abstr. Int. B)

8966 DEUTERIUM THERMOMETER IN FOSSIL PLANTS. Schiegl, W. E. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Radiohydrometrie). Umsch. Wiss. Tech.; 74: No. 13, 421-422 (Jul 1974). (In German).

The deuterium content of plants depends on the temperature during growth. Therefore, the deuterium concentration of fossil plant material can be used as an indicator for the climatic conditions during plant growth. (auth)

8967 THERMAL TOLERANCES OF FISH FROM A RESERVOIR RECEIVING HEATED EFFLUENT FROM A NUCLEAR REACTOR. Holland, W. E.; Smith, M. H.; Gibbons, J. W.; Brown, D. H. (Savannah River Ecology Lab., Aiken, SC). Physiol. Zool.; 47: No. 2, 110-118 (Apr 1974).

The heat tolerances of bluegill (Lepomis macrochirus) subjected to heated effluent from a nuclear reactor was compared with those of bluegill living at normal temperatures. Three of the four study areas were located in the Par Pond reservoir system on the Savannah River Plant near Aiken, South Carolina. The results show that at least one species of warm-water fish can adjust to elevated aquatic temperatures in a natural environment by becoming more tolerant. (CH)

Chemical Effluents

Refer also to abstracts 8906 and 8914.

8968 GROUND WATER POLLUTION. A Bibliography. Summers, W. K.; Spiegel, Z. Ann Arbor, MI; Ann Arbor Science Publishers Inc. (1975). 91p.

This partially annotated bibliography is the product of a concentrated literature search particularly in the areas of ground water contamination by nitrates, heavy metals, pesticides, and herbicides. The impact of urbanization and the effects of solid waste disposal, animal wastes, and petroleum products on ground water quality are covered in the more than 400 entries. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 9238, 10043, and 11088.

General Detectors and Monitors

Refer also to abstracts 9114, 9266, 9268, 10636, and 10743.

8969 (BNWL-CC-2354) OPTIMIZATION OF CERIUM-ACTIVATED GLASS ALPHA SENSORS. Koski, O. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 15 Dec 1969. 20p. Dep. NTIS $4.00.

Alpha detection using scintillating glasses was developed by Upson and adapted for plant service by Huck. The sensor selected for plant service is a cerium-activated Vycor glass type 7913 manufactured by Corning Glass Works. This is a thin film sensor developed by Corning in cooperation with Hanford contractors, based on a bulk glass originally developed by Corning for neutron detection. Plant performance with these sensors has been unsatisfactory in applications involving low alpha counts in the presence of high beta such as the Purex 2AW stream. The results of work directed toward the improvement of plant performance of these sensors are reported, and instructions, procedures and processes useful in producing an optimized alpha sensor from a crude commercial product are detailed. Optimization is defined as lowering the photonproduction per beta particle absorbed without experiencing a similar loss of alpha photonproduction. (auth)

8970 (CEA-R-4648) NEW STATIONARY DETECTOR FOR STUDY OF QUICK PHENOMENA IN NUCLEAR MEDICINE. Gmucher, J. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Div. de la Physique). May 1975. 84p. (In French). Dep. NTIS (US Sales Only) $7.25.

Thesis. Submitted to Paris Univ., France.

The subject of this thesis concerns the study of a new type of scintillation camera, particularly adapted at the study of fast phenomena in nuclear medicine. The first part is a review of the principal devices existing. Limitation of performance is criticized. Then the device using a direct light amplification of the crystal scintillation is studied. New solutions are developed, particularly the coupling mode between the crystal and the photocathode, and the adaptation of a super esicon tube. Results of physical measurements, and transit cardiac pictures obtained at the "Frédéric Joliot Hospital" in Orsay are presented. (auth)

8971 (CONF-730571-, pp 47-51) LOCALIZATION PROPORTIONAL COUNTER FOR THE DETECTION OF X RAYS. Gabriel, A.; Dupont, Y. (Institut des Sciences Nucleaires, Grenoble, France). 1973. (In French).

From colloquium on x rays and matter; Monte Carlo, Monaco (22 May 1973).

In colloquium on x rays and matter, Monte Carlo, Monaco, May 22-26, 1973.

In this detector, the particle detection mechanism is the same as in classical proportional counters. The originality resides in the principle of measurement of the position of the ionizing event. It is made by the comparison of the rise time of pulses emitted at each end of the wire constituting the proportional counter. This very resistant wire constitutes with the walls of the counter a line with constant distributed RC which allows an interpretation of the signal with respect to the line length followed. This results in the localization effect. The measured spatial distribution is 0.16 mm. (tr-auth)

8972 (CONF-730571-, pp 53-61) EVALUATION OF THE PERFORMANCES OF A Si(Li) DETECTOR ADAPTED TO CLASSICAL X DIFFRACTOMETRY. Lauriat, J. R.; Perio, P. (Paris Univ., Orsay, France). 1973. (In French).

From colloquium on x rays and matter; Monte Carlo, Monaco (22 May 1973).

In colloquium on x rays and matter, Monte Carlo, Monaco, May 22-26, 1973.

A Si(Li) detector adaptable to x-ray diffractometry, in place of conventional detectors, is described. Possible application to dispersive and non-dispersive diffractometry are discussed. (tr-auth)

8973 (CONF-750629-1) FLY'S EYE: A COUNTING CAMERA FOR THERMAL NEUTRONS—SOME APPLICATIONS, PROBLEMS, AND PROSPECTS. Davidson, J. B. (Oak Ridge National Lab., Tenn. (USA)). 1975. 28p. Dep. NTIS $4.50.

From symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

An area detector for thermal neutrons based on image intensification techniques is described and some capabilities and limitations of the detection system are discussed. Among the former are high spatial resolution high instantaneous counting rate, electronic zoom, time-gating, and integration. The detector is limited in that the maximum counting rate for a resolution element is 60 regularly spaced counts per second. Also, the nonuniformity of response over the detector limits the useful size and requires point-by-point calibration. In addition, a higher efficiency for neutron detection would be desirable. Some typical applications of the system are: crystal inspection, neutron magnetic diffraction topography, and searches for temperature induced changes in diffraction patterns. The future application of solid state television sensors and microchannel plate intensifiers to improve the system are briefly mentioned. (auth)

8974 (EFI-60(74)) PRELIMINARY DATA ON THE INVESTIGATION OF A DRIFT CHAMBER. Astabatvan, R. A.; Kukarev, V. M.; Mkrtchyan, G. G.; Stepanov, E. G. (Erevanskij Fizicheskij Inst. (USSR)). 1974. 12p. (In Russian). INIS.

Two experimental models of drift chambers were made, one a plane model with a drift distance up to 10 mm, and the other a cylindrical model with a drift distance up to 20 mm. The chambers were filled with a mixture of argon and methane. During operation with a collimated beta source a space resolution of 1.7 mm was obtained for the plane chamber, and a resolution of 1.0 mm was obtained for the cylindrical chamber. It is shown that the accuracy is limited by poor collimation and divergence of the beam of beta particle because of multiple scattering. (SJR)

8975 (GSF-S-296) PROGRAM ELFELD FOR THE DETERMINATION OF ELECTRIC FIELD LINE PATTERNS OF CYLINDRICAL WIRE ARRANGEMENTS. Borst, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz). Jul 1974. 18p. (In German). INIS.

11 figs.; 4 refs. With app.

A fortran computer program is described for the determination and plotting of electric and potential field distributions. This program is laid out for cylindrical wire arrangements surrounded by a conducting tube, especially. (auth)

8976 (GSI-P-3-74, pp 1-19) DRIFT CHAMBERS. Walenta, A. H. 1974. (In German).

From GSI working meeting on detectors; Darmstadt, F. R. Germany (18 Jul 1973).

In GSI working meeting on detectors. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

It was shown that it is possible to measure the position and time of the transmission of a particle through a large-area proportial chamber by measuring the electron-drift time. The experience gained in an experiment at the CERN proton-synchrotron using a magnetic spectrometer with drift chambers showed that these chambers will work without any disturbance in long-time mode of operation at a high particle dose, and that they are comparatively economical in use. (GE)

8977 (GSI-P-3-74, pp 30-41) POSITION-SENSITIVE LOW-PRESSURE PROPORTIONAL CHAMBERS. Specht, H. J. 1974. (In German).

From GSI working meeting on detectors; Darmstadt, F. R. Germany (18 Jul 1973).

In GSI working meeting on detectors. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

The application of low-pressure proportional chambers (lower than 10 Torr) and their energy resolution are discussed. Also, drift and multiwire chambers are described which were developed for the measurement of angular distribution of fission fragments. (GE)

8978 (GSI-P-3-74, pp 42-50) THE MULTI-WIRE PROPORTIONAL COUNTER OF THE MUNICH Q3D-MAGNETIC SPECTROGRAPH AND ITS APPLICATION FOR HEAVY IONS. Glaessel, P.; Specht, H. J. 1974. (In German).

From GSI working meeting on detectors; Darmstadt, F. R. Germany (18 Jul 1973).

In GSI working meeting on detectors. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

A multi-proportional counter is described which was tested at the Munich Q3D-magnetic spectrograph. The filling gas consisted of 80% isobutane and 20% argon. The chamber was used with digital readout for the measurement of spatial and energy spectra of light and heavy ions. (GE)

8979 (GSI-P-3-74, pp 51-69) A POSITION-SENSITIVE PROPORTIONAL COUNTER WITH LOW-RESISTANCE WIRE. Duhm, H. H. 1974. (In German).

From GSI working meeting on detectors; Darmstadt, F. R. Germany (18 Jul 1973).

14 figs.; 1 tab.; 21 refs. Part of a diploma thesis by R. Renfordt.

In GSI working meeting on detectors. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

A position-sensitive proportional counting tube of 60 cm in length is described which is based on the principle of charge division, having a spatial resolution of about 1.5 mm for d particles and ^{7}Li. It consists of a tube with a low-resistance wire of 120 Ω/cm. The possibilities of particle discrimination are discussed for use as detector in the focal plane of magnetic spectrographs. (auth)

8980 (GSI-P-3-74, pp 70-81) A DIVIDED CATHODE, POSITION-SENSITIVE PROPORTIONAL COUNTER. Stoltzfus, J. 1974.

From GSI working meeting on detectors; Darmstadt, F. R. Germany (18 Jul 1973).

In GSI working meeting on detectors. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

A position-sensitive proportional counting tube is described which uses the charge division technique. Tests at the Munich Q3D-spectrograph have shown that a resolution of about 1 mm can be achieved with alpha particles and deuterons in a counter with 10 mm active length. Its use for particle discrimination, the electronic readout system and the design of a 160 cm- counter are discussed. (GE)

8981 (GSI-P-3-74, pp 82-91) AN INTEGRATED dE-E-DETECTOR SYSTEM. Kalbitzer, S.; Kostka, A. 1974. (In German).

From GSI working meeting on detectors; Darmstadt, F. R. Germany (18 Jul 1973).

9 figs.; 1 tab.; 2 refs. Part of a thesis by A. Kostka. Published in Radiat. Eff. (1973), v. 19(2) p. 77-82, and in Appl. Phys. Lett. (1973), v. 23(12) p. 704-705.

In GSI working meeting on detectors. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

Boron and phosphorus ions with energies of 8 MeV and 6 keV, respectively, were implanted into monocrystalline silicium. This n^{+}np^{+}nn^{+}- doudiode detector system resolved ^{241}Am-d-radiation with a halfwidth of about 100 keV. (auth)

8982 (KIYI-74-24) A LOGICAL DEVICE FOR TRACK COUNTING IN NUCLEAR EMULSION. Gofman, Yu. V.; Karlyshev, Yu. Ya.; Majdikov, V. Z.; Shchur, A. M. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1974. 6p. (In Russian). INIS.

A description is given of a logical device which is part of a system for counting the number of tracks in nuclear photoemulsions. Track pulses enter the device from an electronic scanner after passing through an analogue scheme to remove noise and extraneous components of the signal. In the logical device the total number of track pulses on all the scanning lines is read as well as the number of coincidence pulses occurring on comparing the number of pulses of each two neighboring lines in succession. The difference of these numbers is the number of tracks in the frame being scanned. (SJR).

8983 APPLICATION OF THE MINI-SCALER AND SINGLE CHANNEL ANALYZER FOR EASY AND RAPID ASSAY OF BETA SPECTRUM AND ACTIVITY OF ENVIRONMENTAL SAMPLES. Wang, C. L. (National Tsing-Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 4, 216-222(Dec 1974). (In Chinese).

The mini-scaler combined with single channel analyzer is a simple instrument for detecting the beta activity and energy spectrum with a plastic scintillation crystal. This paper describes the applicability of this counting system for the environmental radiation measurement. The result of the experimental calibrations shows that the counting system can be used in the following ways: (1) gross beta counting, (2) identification of an unknown beta emitter, (3) measuring the activity. The counting system is simply constructed, and the power can also be supplied by the charged batteries, so it can be used in the field measurement. (auth)

8984 NEW DETECTOR FOR IONS AND METASTABLE ATOMS. Joshi, S. B.; Prince, R. H.; Ward, T. V. (York Univ., Toronto). Rev. Sci. Instrum.; 46: No. 5, 559-561(May 1975).

A detector for ions and metastable atoms has been designed and evaluated which utilizes a conversion from particle to photon detection. The device is "solar blind" and currently used in shock-tube research in conjunction with a quadrupole mass spectrometer where the insensitivity of the gain to pressure fluctuations is highly advantageous. Preliminary observations of the performance of the detector and its conversion efficiency for various ion species are reported. Values of overall gain are typically 5 x 10^{5} for conversion electrode potentials of 10 kV and a characteristic time constant less than 1 mu sec. (auth)

8985 APERTURE SYNTHESIS IN X-RAY ASTRONOMY. Cruise, A. M. (Mullard Space Science Lab., Dorking, Eng.). Mon. Notic. Roy. Astron. Soc.; 170: No. 2, 305-312(Feb 1975).

A new method of X-ray imaging is described. By combining a number of collimators it is possible to synthesize a useful aperture to record structure in cosmic X-ray sources. Results from computer simulations show this method to be a practical solution to imaging at many photon energies and in many fields of physics. (auth)

8986 THREE-DIMENSIONAL RECONSTRUCTION IN NUCLEAR MEDICINE EMISSION IMAGING. Budinger, T. F.; Gullberg, G. T. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-21: No. 3, 2-20(Jun 1974).

Methods of three-dimensional isotope distribution reconstruction from multiple two-dimensional views are similar to those employed in astrophysics, electron microscopy, and radiology; however, photon attenuation must be taken into account. Successful quantitation of the three-dimensional distribution of isotopes has been achieved using the iterative least-squares technique, but not the Fourier technique. The iterative least-squares technique is superior to other techniques because it handles noise and has been successfully modified to incorporate attenuation. The method has been implemented on the CDC-6600/7600 and on the small computer HP-2100A in FORTRAN. In our first implementation, approximately 20 min of processing per section are required by the small machine. Most algebraic reconstruction techniques do not account for noise, but can reconstruct a section in approximately 1 min, without attenuation correction. Fourier transform techniques are approximately 80 times faster than the least-squares method, but do not handle noise or attenuation. (auth)

8987 GENERAL VIEWS ON 3-D IMAGE RECONSTRUCTION AND COMPUTERIZED TRANSVERSE AXIAL TOMOGRAPHY. Cho, Z. H. (Univ. of California, Los Angeles). IEEE Trans. Nucl. Sci.; NS-21: No. 3, 44-71(Jun 1974).

General views on the physical aspects, mathematical image reconstruction methods and algorithms, and associated detection electronics are given. Transmission techniques are emphasized; however, the technique can be applied to emission studies, for instance in positron cameras. (auth)

Radiation Dosimeters

8988 (DEMO-74/8) INTERCOMPARISON OF DICARBOXYLIC ACIDS AND CYCLOHEXANE DOSIMETERS AND CALORIMETERS IN THE GREEK RESEARCH REACTOR. Radak, B. B.; Gal, O. S.; Marketos, D. G.; Boyd, A. W. (Democritus Nuclear Research Center, Athens (Greece)). Nov 1973. 31p. Dep. NTIS (US Sales Only) $4.75.

For determination of the total dose and its neutron and gamma component in light materials, calorimetric measurements in graphite and polyethylene were chosen; to check the magnitude of the neutron component the fast neutron fluence was measured (Ni-detectors); chemical systems: cyclohexane, oxalic acid solid and in aqueous solution and succinic acid were irradiated in the calibrated position. The choice of chemical systems was made having in mind their features relevant to the intercomparison work. Cyclohexane is a dosimeter in which the radiolytic yield, $G(H_2)$, does not depend on the LET of the radiation; also its formula is, dosimetrically, the same as that of polyethylene, hence the possibility of direct intercomparison of calorimetric and chemical results. Oxalic acid in aqueous solutions is a dosimeter which has been thoroughly investigated in different radiation fields, particularly in reactor cores; solid oxalic acid has shown to be a promising in-pile dosimeter in the range of very high doses. Results are presented and discussed. (WHK)

8989 (LA-5927-MS) EVALUATION OF LITHIUM BORATE AS A 7000-R DOSIMETER. Holm, D. M.; Payne, R. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1975. Contract W-7405-ENG-36. 6p. Dep. NTIS $4.00.

The Harshaw Model 2271 TL Detector/Dosimeter system with lithium borate dosimeters was evaluated as a 7000-R dosimetry system. One hundred dosimeter cards having two dosimeters per card were irradiated up to ninety-eight times with x rays from a 250-keV (electron energy) GE x-ray machine. A twofold change in calibration was observed during the course of 98 irradiation cycles and a decrease in light output versus time lag between irradiation and reading was observed. The first card "failed" on the 36th cycle and only two cards survived to the 98th cycle. All of the failures were due to damage of the Teflon packaging, causing the dosimeters to hang up in the readout or to move in their card. This system could be used for screwworm fly dosimetry but is not considered ideal. (auth)

8990 (LCA-74-R-006) DEVELOPMENT OF A 250 TO 4000 RAD CHEMICAL DOSIMETER. Le Teurnier, D. (Laboratoire Central de l'Armement, 94 - Arcueil (France)). 15 Nov 1973. 22p. (In French). INIS.

The principles of the Fricke dosimeter are reviewed. Its construction is discussed in the framework of the limitations encountered. A method was developed in which the Fe^{3+} ion

is complexed by potassium thiocyanate. In this way, γ radiation doses of the order of 250 rads can be measured. (FR)

8991 (ORO-4814-4) RECENT DEVELOPMENTS IN FAST NEUTRON PERSONNEL DOSIMETRY USING TRACK ETCH METHODS. Sohrabi, M.; Morgan, K. Z. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). 1974. Contract AT(40-1)-4814. 5p. (CONF-750518-3). Dep. NTIS $4.00.

From third European IRPA congress; Amsterdam, Netherlands (13 May 1975).

Direct fast-neutron-induced recoil and (n,alpha) particle tracks in polymers, in particular Lexan polycarbonate, employing electrochemical etching technique provide a simple, sensitive, and inexpensive method of fast neutron dose measurements. This is considered as an alternative method to the use of NTA films and fission fragment registration technique for fast neutron personnel dosimetry. Response of recoil particle track registration in Lexan polycarbonate as a function of fission neutron dose, directional response, energy dependence, fading characteristics, etc. are given, using electrochemical etching technique. The possibility of proton track registration in polycarbonate is discussed. The direct interaction method covers a wide dose range from 1 mrad to 1000 rads. It is concluded that the technique can be applied for fast neutron personnel dosimetry (routine and criticality accidents), patient monitoring during a neutron therapy trial, and many other health physics and therapy applications. (auth)

8992 (UCRL-76808) STUDIES OF NEUTRON DOSIMETRY AT THE LAWRENCE LIVERMORE LABORATORY. Hankins, D. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. 18p. (CONF-750528-1). Dep. NTIS $4.00.

From fifth workshop on personnel neutron dosimetry; Gaithersburg, Maryland, USA (6 May 1975).

Topics include a comparison study of remmeters, evaluation of neutron exposures from LLL personnel TLD badges, and calibration factors for albedo neutron dosimeters. (WHK)

8993 IMPORTANCE OF THE CALIBRATION OF ALL OF THE PARAMETERS AFFECTING RADIATION EXPOSURE MEASUREMENT. McCarthy, W.A. (Victoreen Instrument Division, Cleveland, Ohio 44104). Med. Phys. 2: No. 2, 83-84 (Mar 1975).

A radiation calibration error at Victoreen is reported and the background history and immediate cause are discussed. (auth)

8994 VICTOREEN CALIBRATION "DISCREPANCIES" NOTED. Gray, L. (Department of Therapeutic Radiology, Yale University School of Medicine, The Yale-New Haven Hospital, New Haven, Connecticut 06504). Med. Phys. 2: No. 2, 82-82 (Mar 1975).

Errors of 12% are noted for condenser R-Meters calibrated at the Victoreen Laboratory. Radiotherapists relying on these factors are cautioned to verify the calibration of each ionization chamber. (auth)

Nuclear Spectroscopic Instrumentation

8995 (BLG-493) ANALYSIS OF A BACKGROUND ELIMINATION METHOD IN THE ^{6}Li SPECTROMETRY TECHNIQUE. de Leeuw-Gierts, G.; de Leeuw, S.; Kamboj, B. K. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Jun 1974. 6p. INIS.

A new method to eliminate the background in the ^{6}Li spectrometry technique is discussed and applied. The method is based on a simultaneous analysis of the stopping power and the energy of the emitted alpha and triton particles. This direct background elimination technique is tested in the MOL-ΣΣ fast assembly. (auth)

8996 (CEA-CONF-2976) HIGH FIELD MOESSBAUER SPECTROSCOPY USING WATER-COOLED MAGNETS. Chappert, J.; Regnard, J. R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale; Centre National de la Recherche Scientifique, 38-Grenoble (France)). 1974. 12p. (CONF-7409105-1). Dep. NTIS (US Sales Only) $4.00.

From international conference on physics under intense magnetic fields; Grenoble, France (18 Sep 1974).

A high-field Moessbauer spectrometer using a Bitter coil producing fields of up to 155 kOe is described. Problems encountered in the design of this type of equipment are discussed and preliminary results demonstrating the performance of the spectrometer are presented. (auth)

8997 (CEA-R-4639) STUDY ON THE ELECTRONIC COLLECTION IN LIQUID XENON DETECTOR: APPLICATION TO GAMMA RAY SPECTROMETRY. Gadenne, M. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette(France). Div. de la Physique). Apr 1975. 72p. (In French). Dep. NTIS (US Sales Only) $6.75.

A three-electrode xenon liquid filled ionization chamber, of 5 cm diameter and 5.3 cm length was built in order to test its performance in gamma ray spectrometry, because xenon has theoretically several advantages in comparison with NaI(Tl) and Ge(Li) detectors. A thin gamma ray beam from a ^{60}Co source produces ionizations in liquid slices at different distances from the electrodes, i.e., in every case, the two full absorption peaks of 1.17 MeV and 1.33 MeV are separated on the spectra. The energy resolution is equal to 11% for 1.33 MeV. A discussion of the different parameters which affect the resolution is proposed. Measurements of charge numbers indicate that the average energy necessary to produce an ionization is less in liquid xenon than in gas, and thereby the liquid xenon is a material of detection particularly interesting. Some applications are proposed. (auth)

8998 (COO-221-31) ENERGETIC-NEUTRON SPECTROMETRY. Progress Report, 1 April 1974-31 May 1975. Madey, R.; Waterman, F. M.; Baldwin, A. R. (Kent State Univ., Ohio (USA)). 1975. Contract E(11-1)-2231. 10p. Dep. NTIS $4.00.

During the past year, the capability of the neutron spectrometer was extended to measure two parameters and it was used to measure omnidirectional neutron spectra in the energy region from about 5 to 150 MeV. Several electronic modules, not commercially available, were designed and constructed to meet the specific requirements for the two-parameter version. The response of the new scintillator, NE-228A, to protons was calibrated at the Ohio University Accelerator Laboratory. The two-parameter spectrometer was tested and calibrated at different stages of the spectrometer development by measuring neutron spectra at 0^{0} from 83.7 MeV proton bombardment of thick beryllium targets at the University of Maryland cyclotron. A most beneficial fallout revealed by these tests is the ability of the two-parameter spectrometer to measure unidirectional neutrons in a more stringent background environment or at particle accelerators with a lower duty cycle than is possible with the one-parameter version. To demonstrate the feasibility of utilizing a two-parameter spectrometer to measure omnidirectional neutrons, the neutron skyshine and the skyshine source spectra from the Brookhaven Alternating Gradient Synchrotron were measured. (auth)

8999 (GSI-P-3-74, pp 20-29) AN IONIZATION CHAMBER FOR DETERMINING THE NUCLEAR CHARGE OF FISSION FRAGMENTS. Sistemich, K. 1974. (In German).

From GSI working meeting on detectors; Darmstadt, F. R. Germany (18 Jul 1973).

In GSI working meeting on detectors. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)).

An ionization chamber was developed for the determination of the nuclear charge of fission fragments. The chamber has been designed for use in the parobola spectrometer LOHENGRIN at the high-flux reactor of the institute Laue-Langevin, Grenoble. This spectrometer is suitable for measuring the yield of nuclides because it separates the unmoderated fission fragments according to masses and energies. For a filling gas of 95% Ar and 5% CO_2, an energy resolution of about 2.4% was achieved. It is possible to compute the nuclear charge from the energy loss of the fission fragments in the gas. (GE)

9000 (JINR-P3-8589) SPECTROMETER FOR INVESTIGATION OF THE NEUTRON SMALL ANGLE SCATTERING BY THE TIME-OF-FLIGHT METHOD (THEORY). Gladkikh, I.; Ostanevich, Yu. M.; Cher, L. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The expressions are obtained for the resolution, intensity and resolution function of a spectrometer for small angle scattering measurements by the time-of-flight method. The relations that optimize the spectrometer luminosity are given. It is shown that cooling of the moderator increases luminosity as $T^{-2.5}$. The analytical form of the resolution function is found. (auth)

9001 (LA-UR-75-880) PRELIMINARY DESIGN AND PERFORMANCE OF AN ADVANCED GAMMA RAY SPECTROMETER FOR FUTURE ORBITER MISSIONS. Metzger, A. E.; Parker, R. H.; Arnold, J. R.; Reedy, R. C.; Trombka, J. I. (Los Alamos Scientific Lab., N. Mex. (USA)). 7 May 1975. Contract W-7405-eng-36. 29p. (CONF-750344-2). Dep. NTIS $4.50.

From 6th lunar science conference; Houston, Texas, USA (17 Mar 1975).

A knowledge of the composition of planets, satellites and asteroids is of primary importance in understanding the formation and evolution of the solar system. Gamma-ray spectroscopy is capable of measuring the composition of meter-depth surface material from orbit around any body possessing little or no atmosphere. Measurement sensitivity is determined by detector efficiency and resolution, counting time and the background flux while the effective spatial resolution depends upon the field-of-view and counting time together with the regional contrast in composition. The advantages of using germanium as a detector of gamma rays in space are illustrated experimentally and a compact instrument cooled by passive thermal radiation is described. Calculations of the expected sensitivity of this instrument at the Moon and Mars

show that at least a dozen elements will be detected, twice the number which have been isolated in the Apollo gamma-ray data. (auth)

9002 (RD/B/N-3221) MODIFICATION OF AN ENERGY DISPERSIVE X-RAY SPECTROMETER TO ALLOW ANALYSIS OF RADIOACTIVE SPECIMENS. Baker, C.; Rickards, G. K. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1974. 11p. Dep. NTIS (US Sales Only) $4.00.

An energy dispersive x-ray spectrometer used in conjunction with transmission or scanning electron microscopy allows rapid element analysis. Radioactive specimens, however, present a problem in that the spectrometer collects the β/γ radiation. This results in a high background level or in saturation of the collection system. The collimator of the detection system on a KEVEX energy dispersive analyser has been modified so that only β/γ radiation over a small solid angle is collected. The modified collimator accurately sights on the area being irradiated by the electron spot and consequently very good signal to background ratios are obtained. An example is reported of the analysis of fission product precipitates in SGHWR fuel pins. (auth)

9003 (Y-DA-6254) SOME APPLICATIONS OF SEMICONDUCTOR X-RAY AND GAMMA DETECTORS TO NONDESTRUCTIVE TESTING. Snow, S. G. (Oak Ridge Y-12 Plant, Tenn. (USA)). 26 Mar 1975. Contract W-7405-eng-26. 30p. Dep. NTIS $4.50.

Use of semiconductor X-ray and gamma detectors for coating thickness and composition measurements is described. Advantages and limitations of these detectors are shown through examples of tests developed at the Y-12 Plant. (auth)

9004 PHOTOELECTRON SPECTROSCOPY BY TIME-OF-FLIGHT TECHNIQUE USING SYNCHROTRON RADIATION. Bachrach, R. Z.; Brown, F. C.; Hagstroem, S. B. M. (Xerox Palo Alto Research Center, CA). J. Vac. Sci. Technol.; 12: No. 1, 309-312(1975).

A time-of-flight spectrometer for photoelectron spectroscopy is described. It is based on the pulsed structure of the synchrotron radiation emitted from the storage ring (SPEAR) at SLAC with a pulse width of 1.5 ns and a repetition period of 780 ns. The sample is irradiated with monochromatic light from a soft x-ray grazing incidence monochromator which works in the photon energy range of 25 to 1500 eV. The time-of-flight spectrometer consists of a 6 in. mu-metal drift tube which can be pivoted around the sample making angularly resolved photoelectron spectroscopy feasible in both the horizontal and vertical direction. On the sample side of the drift tube a retardation sector is attached and on the other side, a fast channelplate detector. The design parameters are 100 MeV energy resolution at 5 eV and 1^0 angular resolution. Some preliminary results on Si single crystals are described. (auth)

9005 DEVELOPMENT OF A NEUTRON TIME-OF-FLIGHT SPECTROMETER AND INVESTIGATION OF THE REACTION $^{27}Al(p,n)^{27}Si$. Klages, H. O. Hamburg; Univ. Hamburg (1973). 81p. (In German). INIS.

Thesis.

The conception, the development and testing of a spectrometer for fast neutrons, is described; and the measurement and analysis of the neutron angular distribution of the reaction $^{27}Al(p,n)^{27}Si$ at proton energies from 10.5 to 22.5 MeV is discussed. Transitions to the ground state and to 6 excited levels of ^{27}Si are contained. Model calculations for the dominating reaction mechanism at the different energies are reported. (GE)

9006 THE GEYSER, A NEW DETECTOR FOR NUCLEAR RECOILS. Hahn, B.; Reist, H. W. (Bern Univ. (Switzerland)). pp 432-435 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A new method of extreme simplicity for detecting heavily ionizing particles, e.g., nuclear recoils, has been found. A suitable liquid of large volume, containing a desired dissolved material is superheated. For a given ionizing power of a particle there is a sharp threshold sensitivity. The detector is for low level counting and is continuously sensitive. (auth)

High Energy Physics Instrumentation

Refer also to abstracts 9639 and 9657

9007 (CERN-74-9(Vol.1), pp 98-110) CRYOGENICS. Firth, M. 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

In meeting on technology arising from high-energy physics, CERN, Geneva, 24-26 April, 1974, proceedings. I. Review papers. (European Organization for Nuclear Research, Geneva (Switzerland)).

The paper reviews some physical properties of materials at low temperatures and the general techniques which are used to produce and maintain temperatures in the liquid-hydrogen and liquid-helium region. Applications of low-temperature technology encountered in high-energy physics are described, with particular reference to refrigeration, hydrogen and polarized targets, liquid-hydrogen bubble chambers, superconducting devices and condensation cryopumping. (INIS)

9008 (CERN-74-9(Vol.2)(Ed.2)) MEETING ON TECHNOLOGY ARISING FROM HIGH-ENERGY PHYSICS, CERN, GENEVA 24-26 APRIL, 1974, PROCEEDINGS. II. Technology Notes. Jesse, A.; Taylor, C. S. (European Organization for Nuclear Research, Geneva (Switzerland)). 15 Jun 1974. 693p. INIS.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

Contains 255 technology notes related to the individual exhibits of this meeting.

The 2nd volume contains the 255 Technology Notes which were used originally as brief documentation handed out at the individual exhibit stands during this meeting. Each Technology Note contains information on why the subject of a particular exhibition was of importance, how the design, construction, or development was undertaken, what were the special problems, which firms were involved, and who may be contacted for further information. The Notes are grouped in the following categories: X = General and large installations, B = Beams and radiation, C = Cryogenics and superconductivity, D = Data processing, E = Electronics, M = Magnets and electricity, P = Photography and optics, V = Vacuum, W = Workship techniques and general engineering. Appended is a bibliography of CERN publications concerning technology, listing some 600 references (1969-1974) in the above categories. (INIS)

9009 (CONF-740713-, pp II.24-II.25) SPECTROMETERS FOR MESON PHYSICS. Dowell, J. D. (Univ. of Birmingham, Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A short summary is given of the content of six contributed papers to the XVII International Conference on High Energy Physics (London) 1974 covering the subject of spectrometers for meson physics. The points covered by the papers included acceptance corrections, resolution, particle identification, backgrounds, sensitivity (events/μb), pattern recognition and computing times per event, and the described experimental programs for existing spectrometers. Brief descriptions of two spectrometers still under construction, LASS(SLAC) and MPS (Brookhaven) were also given. (UK)

9010 (CONF-750544-1) CALCULATIONAL APPROACH TO IONIZATION SPECTROMETER DESIGN. Gabriel, T. A. (Oak Ridge National Lab., Tenn. (USA)). 1974. 16p. Dep. NTIS $4.00.

From International workshop on spectrometer design; Batavia, Illinois, USA (9 May 1975).

Many factors contribute to the design and overall performance of an ionization spectrometer. These factors include the conditions under which the spectrometer is to be used, the required performance, the development of the hadronic and electromagnetic cascades, leakage and binding energies, saturation effects of densely ionizing particles, nonuniform light collection, sampling fluctuations, etc. The calculational procedures developed at Oak Ridge National Laboratory that have been applied to many spectrometer designs and that include many of the influencing factors in spectrometer design are discussed. The incident-particle types which can be considered with some generality are protons, neutrons, pions, muons, electrons, positrons, and gamma rays. Charged kaons can also be considered but with less generality. The incident-particle energy range can extend into the hundreds of GeV range. The calculations have been verified by comparison with experimental data but only up to approximately 30 GeV. Some comparisons with experimental data are also discussed and presented so that the flexibility of the calculational methods can be demonstrated. (auth)

9011 (KFK-EXT-3/74-10) LIQUID ARGON IONISATION CALORIMETER FOR DETECTION OF ELECTROMAGNETIC AND HADRONIC SHOWERS. Hofmann, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Feb 1975. 141p. (In German). Dep. NTIS (US Sales Only) $10.25.

The performance of a liquid argon ionization chamber, consisting of a set of eighty 2 mm thick iron plates, is described. Measurements with muons, and electron and proton showers were

performed; from these measurements a ratio of 1.2 for the electron to proton response was derived. For hadron showers a good detection efficiency of nuclear spallation products could be established. (auth)

9012 AUTOMATIC MEASUREMENT OF STREAMER CHAMBER IMAGES. Stolze, C. Aachen; Technische Univ. (1972). 61p. (In German). INIS.

Thesis.

Streamer chamber images used for determination of ionization are interpreted automatically. The images are scanned by a digital controlled flying spot. The high-accuracy cathode-ray tube is connected with an input computer device. The identification and the measuring are performed by using extensive computer programmes. (GE)

Radiometric Instruments

Refer also to abstract 9051.

9013 (N-74-33159) NUCLEAR PROSPECTORS OF EARTH AND SPACE OBJECTS. Filippov, E. M. Sep 1974. Translated from pp 1-138 of Yadernye Razvedchiki Zemnykh i Kosmicheskikh Obektov, Nauka Press, Novosibirsk, 1974. (NASA-TT-F-15140). 156p.

Nuclear geophysics is reviewed beginning with a treatment of the distribution of radioactive elements in the land, sea, and meteorites. Nuclear unmanned prospecting landers intended for use on Mars, Venus, the Moon, and Jupiter are described. Nuclear densimeters, moisture meters, specialized element detectors, well-logging devices, neutron and X-ray tubes are described as developed in the U. S. S. R. and abroad. Particle accelerators as applied in geophysics and geology are discussed. (auth)

9014 (USIP-74-30) NUCLEAR GAMMA RESONANCE CRYOSTAT SYSTEM FOR MEASUREMENTS BETWEEN 1 AND 300 KELVIN. Cederstroem, C.; Grapengiesser, S.; Helgeson, U.; Moberg, L. C. (Stockholm Univ. (Sweden). Fysiska Institutionen). Dec 1974. 23p. Dep. NTIS (US Sales Only) $4.50.

A Nuclear Gamma Resonance (Mössbauer) cryostat system for temperature measurements between 1 K and 300 K is described. Both the absorber and the radioactive source are cooled to low temperatures. This is important when the f-factors are small. It is also possible to cool the source only with a standard absorber at room temperature. (auth)

9015 RESPONSE CHARACTERIZATION OF THE TRITIUM IONIZATION CROSS-SECTION DETECTION. Colson, E. R. (Gas and Fuel Corp., Victoria, Australia). Anal. Chem.; 47: No. 6, 805-815(May 1975).

Seven binary gas mixtures were fed to either, or both, of two tritium ionization cross-section detectors in order to find a general characterizing relation. A relation was found between a defined detector response parameter (Y) and molar composition. A single regression coefficient relation was also proposed. The root mean square of the percentage difference between observed and calculated detector response, over the 130 more accurately blended mixes of the 291 observation pairs reported, was 0.32 percent. Under favorable conditions, the detector responded to composition changes of 50 to 100 ppm. (auth)

9016 ATMOSPHERIC PARTICULATE MASS MONITORING WITH A β-RADIATION DETECTOR. Dalager, S. (ENVIROPLAN A/S, Copenhagen). Atmos. Environ.; 9: No. 3, 369-370(Mar 1975).

Comments are made on the paper by Husar (Atmos. Environ.; 8: 183-8 (1974). Atmospheric Particulate Mass Monitoring with a β-radiation detector) concerning the calibration procedure of the instrument used. It is stated that the instrument (a β-Staub-monitor FH 62 A) must have been modified to obtain the readings quoted in Dr. Husar's paper and also that the sampler was only calibrated indirectly although the manufacturers recommend a direct calibration procedure. It is thought that further research into the β-absorption properties of atmospheric particulates is needed before the general applicability of these samplers can be evaluated. (UK)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

9017 MILITARY TURNING TO CMOS/SOS FOR RADIATION-HARDENED CIRCUITRY. Kaye, D. N. Electron Des.; 23: No. 7, 26-28(1 Apr 1975).

Military-sponsored research on radiation-hardened CMOS/SOS circuitry is briefly reviewed. Most of the testing so far has been on logic circuits. (WHK)

Miscellaneous Instruments

Refer also to abstracts 8461, 8462, 9239, 9581, and 11102.

9018 (GA-A-13241) MEAN TIME TO FAILURE OF HIGH TEMPERATURE THERMOCOUPLES IN IRRADIATION CAPSULES. Jacobsen, F. K. (General Atomic Co., San Diego, Calif. (USA)). 20 Feb 1975. Contract AT(04-3)-633. 7p. Dep. NTIS $4.00.

The results of calculations of the mean time before failure of thermocouples as a function of temperature and neutron flux are presented. These thermocouples were used in the performance of in-reactor tests of the coated particle fuel for use in high-temperture gas-cooled nuclear reactors. The results cover 429 type K chromel-alumel thermocouples tested in an atmosphere of helium and argon gas at temperatures of 300 to 1000°C, at fast neutron (E greater than 0.18 MeV) fluxes of 1.44×10^{13} to 6.48×10^{14}, for periods up to 6000 hours. (auth)

9019 (JINR-13-8044) FAST DECADE SCALER WITH THE DISPLAY IN THE CAMAC STANDARD. Basiladze, S. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 8p. (In Russian). INIS.

6 refs.; 3 figs.

A fast decade scaler with response speed of 120 MHz, maximum capacity of 10^8, and display on the front panel was described. Switching to a two-scaler regime up to 10^4 is possible. The unit has a cut-off to overfilling a given decade and is located in the CAMAC assembly. (tr-auth)

9020 (LBL-3820) ACCURACY OF SINGLE PHOTOELECTRON TIME SPREAD MEASUREMENT OF FAST PHOTOMULTIPLIERS. Leskovar, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 28 Mar 1975. Contract W-7405-eng-48. 11p. (CONF-750534-1). Dep. NTIS $4.00.

From international conference on electronics instrumentation and measurements; Paris, France (26 May 1975).

The accuracy of time spread measurements of fast photomultipliers was investigated, using single photoelectrons. The effect of the finite light pulse width on the measurement accuracy was determined and discussed. Experimental data were obtained on a special measuring system for light pulse widths ranging from 200 psec to 10 nsec, using fast photomultipliers 8850 and C31024 with optimized operating conditions for minimum transit time spread. A modified exponential function expression and curve-fitting parameters are given, which fit closely the experimentally obtained data over a wide dynamic range of light pulse widths. (auth)

9021 (ORNL-4958) POWER SYSTEM EMP PROTECTION. Final Report. Marable, J. H.; Barnes, P. R.; Nelson, D. B. (Oak Ridge National Lab., Tenn. (USA)). May 1975. Contract W-7405-eng-26. 85p. Dep. NTIS $5.45.

Voltage transients induced in electric power lines and control circuits by the electromagnetic pulse (EMP) from high-altitude nuclear detonations may cause widespread power failure and damage in electric power systems. This report contains a parametric study of EMP power line surges and discusses protective measures to minimize their effects. Since EMP surges have considerably greater rates of rise than lightning surges, recommended standards and test procedures are given to assure that surge arresters protect equipment from damage by EMP. Expected disturbances and damage to power systems are reviewed, and actions are presented which distribution companies can take to counter them. These include backup communications methods, stockpiling of vulnerable parts, repair procedures, and dispatcher actions to prevent blackout from EMP-caused instabilities. A long-range program is presented for improving distributors' protection against EMP. This involves employee training, hardware protection for power and control circuits, and improvement of plans for emergency action. (auth)

9022 (WANL-TME-098) THERMOCOUPLES, TUNGSTEN/TUNGSTEN-26% RHENIUM, FOR USE IN NUCLEAR REACTORS. Preliminary Specifications. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 9p. Dep. NTIS $4.00.

A preliminary draft of specifications (subject to modification) covering the requirements of the Westinghouse Astronuclear Laboratory for metal-sheathed tungsten/tungsten-26% rhenium thermocouples for use in a nuclear radiation environment is given. (auth)

9023 ELECTRODELESS CONDUCTANCE MEASUREMENT DEVICE. Koski, O. H. (to U.S. Atomic Energy Commission). US Patent 3,867,688. G01n27/42. 18 Feb 1975. Filed date 18 Dec 1973. 4p.

PAT-APPL-425,919.

A device is provided for electrodeless measurement of the conductance of a material for special use in measuring nuclear separation processes. A damped oscillatory signal is applied to the primary winding of a first transformer ring core. A current

loop, including as part of its path the material and carrying a current in response to a signal of the primary winding, couples the first core to a second transformer ring core by acting as a secondary winding for the first core and as a primary winding for the second core. The peak current in a secondary winding of the second core due to and corresponding to the current in the loop and the peak voltage across the loop, which is constant for all materials at the instant the damped oscillatory signal is applied to the primary winding, gives the conductance of the loop. (auth)

9024 CARBON ACTIVITY METER. Roy, P.; Krankota, J. L. US Patent 3,865,709. G01n27/46. 11 Feb 1975. Filed date 2 Nov 1973. 4p.
PAT-APPL-412,396.

A carbon activity meter utilizing an electrochemical carbon cell with gaseous reference electrodes having particular application for measuring carbon activity in liquid sodium for the LMFBR project is described. The electrolyte container is electroplated with a thin gold film on the inside surface thereof, and a reference electrode consisting of CO/CO_2 gas is used. (auth)

9025 LASER MODIFICATION TO AN X—RAY COLLIMATOR: AN AID IN POSITIONING PATIENTS FOR NEUROSURGICAL AND RADIOGRAPHIC PROCEDURES. Galkin, B.M.; Vogel, H.B.; McArdle, G.H.; Baust, G.F.; Boon, R.; O'Donnell, V. (Thomas Jefferson University, Philadelphia, Pennsylvania 19107). Med. Phys. 2: No. 2, 79-81 (Mar 1975).

In high-ambient-light levels such as are found in operating rooms, and at long target-to-patient distances, the cross lines and light field projected from conventional x-ray collimators are not easily visible and proper patient positioning is difficult. The collimators on two mutually perpendicular x-ray units have been modified by replacing the incandescent bulbs with lasers and adjusting the lasers to be coaxial with the x-ray beams. These modifications have been coupled with a third wall-mounted laser to facilitate patient positioning for stereotaxic thermal hypophysectomy. The use of the laser-modified collimators has resulted in considerable saving of time for the operating team and has markedly reduced patient anesthesia time. The laser-modified collimator has also been found useful in positioning patients for other radiographic procedures in the operating room and has virtually eliminated retakes due to malpositioning. (auth)

9026 SIMPLE METHOD FOR THE GENERATION OF ORGAN AND VESSEL CONTOURS FROM ROENTGENOGRAPHIC OR FLUOROSCOPIC IMAGES. Newell, J.D.; Keller, R.A.; Baily, N.A. (University of California, San Diego, Department of Radiology, La Jolla, California 92037). Med. Phys. 2: No. 2, 73-75 (Mar 1975).

A simple method is described for outlining or contouring any area defined by a change in film density or fluoroscopic screen intensity. The entire process, except for the positioning of an electronic window, is accomplished using a small computer having appropriate software. The electronic window is operator positioned over the area to be processed. The only requirement is that the window be large enough to encompass the total area to be considered. (auth)

9027 ELECTROSTATIC FIELDS IN IONOGRAPHY. Plewes, D.; Johns, H.E. (Department of Medical Biophysics, University of Toronto and The Division of Physics, Ontario Cancer Institute, Toronto, Ontario, Canada M4X 1K9). Med. Phys. 2: No. 2, 61-72 (Mar 1975).

There is renewed interest in diagnostic radiology in electrostatic methods of imaging, such as xeroradiography and ionography. This is due to the fact that edge contrast can be achieved, aiding in the visualization of soft tissue tumors. In analyzing the image forming properties of these systems, we chose to solve the electrostatic problems by the method of images. We present methods and recursion formulas for calculating electrostatic fields due to (a) any charge distribution on a slab of dielectric (the solution involves a single infinite series) or (b) the same as the above with the introduction of an additional ground plane parallel to the dielectric surface (the solution now involves double infinite series). Analysis of these fields suggests new methods of controlling edge contrast and development configurations where the field which penetrates through the foil is used to produce the final image rather than the field above the charged surface. (auth)

9028 SWITCHING REGULATOR EMISSION CONTROL CIRCUIT FOR ION SOURCES. Clay, F. P. Jr. (Old Dominion Univ., Norfolk, VA); Brock, F. J.; Melfi, L. T. Jr. Rev. Sci. Instrum.; 46: No. 5, 528-532(May 1975).

An electron emission control circuit of the switching regulator type operating at 100 kHz has been developed which maintains a constant emission current within 0.1 percent for a cathode power demand variation of approximately 100 percent. The power output stage has an efficiency of 67 percent, and the overall efficiency is 45 percent when driving a thoria-coated iridium cathode having a nominal resistance at operating temperature of 2.5 OMEGA. Under optimum conditions, the bus power demand is 1.75 W. The circuit is useful in controlling the electron emission current of ion sources in applications which involve a substantial variation of the cathode work function, such as oxygen partial pressure measurements over a large dynamic range. (auth)

9029 QUADRUPOLE MASS SPECTROMETER FOR THE IDENTIFICATION AND CHARACTERIZATION OF NEUTRAL FRAGMENTS FORMED BY THE INTERACTION OF ELECTRONS WITH GASEOUS MOLECULES. Reeher, J. R.; Svec, H. J. (Ames Lab., IA). pp 509-515 of Advances in Mass Spectrometry. Volume VI. West, A. R. (ed.). Barking, Eng.; Applied Science Publishers Ltd. (1974).

Although indirect methods, such as metastable ion transitions, isotopic labelling, and deconvolution of ionization efficiency curves, are available for deducing the makeup of neutral fragments, methods for direct detection have had limited success. However, a quadrupole mass spectrometer with a modified ion source and ion detection system for characterizing the neutral fragments formed in a mass spectrometer ion source has been developed recently and is described. (WHK)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 8517 and 8715–8716.

9030 (CONF-750209-S1) URANIUM ENRICHMENT CONFERENCE, FEBRUARY 13-14, 1975, OAK RIDGE, TENNESSEE. Toll Enriching Contracting. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). 1975. 25p. Dep. NTIS $4.00.

From uranium enrichment conference; Oak Ridge, Tennessee, USA (13 Feb 1975).

A transcript of the question and answer session of the conference is presented. (TFD)

9031 (GAT-827) OPERATING EXPERIENCE WITH ALUMINUM BEARINGS AT THE PORTSMOUTH GASEOUS DIFFUSION PLANT. Langebrake, C. O. (Goodyear Atomic Corp., Piketon, Ohio (USA)). 16 Jun 1975. Contract AT(33-2)-1. 9p. Dep. NTIS $4.00.

Considerable operating experience has been gained at the Portsmouth Gaseous Diffusion Plant over the last 15 years in the use of aluminum bearings in process related and auxiliary equipment. All of this experience has been excellent and, in several cases, the use of this type of bearing material has solved significant operating problems. Aluminum 850-T101 alloy was first used as a bearing material in purge cascade (PC-9) centrifugal compressors where a fatigue problem was being experienced with babbitt-type bearings. Good experience in this application led to the extended use of this bearing material in other equipment including process related as well as auxiliary equipment. Since 1961 aluminum bearings have been installed in approximately 21 Type PC-9 (centrifugal), 97 Type 9 (centrifugal), 262 Type X-29 (axial), and 101 Type 31 (axial) compressors, and 3 speed increasers in the X-330 Evacuation Booster Station. Based on successful operation of these bearings, continued and expanded use of aluminum bearings is recommended as a means of obtaining a high fatigue resistant bearing at a cost lower than that for babbitt-type bearings. (auth)

9032 (KFK-2067) PRESENT STATE AND DEVELOPMENT POTENTIAL OF SEPARATION NOZZLE PROCESS. Becker, E. W.; Bier, W.; Ehrfeld, W.; Schubert, K.; Schuette, R.; Seidel, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Kernverfahrenstechnik). Sep 1974. 29p. INIS.

From Gordon research conference on physics and chemistry of isotopes; Pacific Grove, Calif. (1 Jul 1974).

The development work on process technology is carried out by the KFK in cooperation with the STEAG AG, Essen. Two prototype separative stages of different size have been installed which allow to construct separation nozzle plants with a separative capacity of 5×10^5 to 1×10^6 kg USW/year without any connection of stages in parallel. Life and performance tests of commercially fabricated separation elements used in these stages show that the separative work capacity of these elements up to now has not changed over a period of 22,000 and that uniform separation characteristics are ensured. At the present state of development separative capacities up to 50 kg USW/year can be achieved with one commercial separation element, which has a diameter of 15 cm and a length of 2 m. Theoretical and experimental studies on separation nozzle cascades indicate that inherently stable operating characteristics exist. Based on this engineering work and on complete design studies for a demonstration plant, the economics of the separation nozzle process has been analysed. It is shown by these studies that separative work costs of less than $50 per kg USW can be expected on the basis of the 1977 technology, if power costs of 9 mills/kWh and plant capacities of 2.5×10^6 kg USW/year are assumed. Besides the development work on process engineering extensive studies have been carried out on the physics of the separation nozzle method. As a result of systematic optimization of the nozzle parameters the power utilization index of the process has been improved by a factor of 2 in the past few years. Studies now under way show a potential for significant further increase in separation factor through delaying UF_6 sedimentation in the centrifugal field of the flow. It is expected that the separation nozzle process will result in considerably lower separative work costs within a few years as compared to the other methods for the separation of uranium isotopes. (auth)

9033 (TID-3347-R) URANIUM ISOTOPE SEPARATION. Davis, T. F.; Kinser, H. W. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jun 1975. 120p. Dep. NTIS $5.45.

This bibliography contains abstracts of unclassified technical reports and journal articles which have appeared in Nuclear Science Abstracts from 1948 through 1974 (Vol. 1–30) pertaining to uranium isotope separation. (auth)

9034 (UCRL-50021-74, pp 483-508) LASER ISOTOPE SEPARATION. Mar 1975.

In laser program annual report, 1974. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

An overview of the experimental facilities and research programs at the Lawrence Livermore Laboratory on laser isotope separation for uranium enrichment is presented. (TFD)

9035 (UCRL-76306(Supp.)) EXCITED STATE SPECTROSCOPY OF ATOMIC URANIUM. Solarz, R.; Carlson, L.; May, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Apr 1975. 12p. (CONF-750456-1). Dep. NTIS $4.00.

From Optical Society of America spring conference; Palo Alto, California, USA (28 Apr 1975).

The photoionization scheme for laser isotope separation of uranium isotopes is discussed with the aim of showing its advantage over gaseous diffusion or centrifuge plants. (TFD)

9036 GAS CENTRIFUGATION IN THE ISOTOPIC ENRICHMENT OF URANIUM. Clement, J. M. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 18: No. 92, 383-389(1974). (In Spanish).

The present article is part of a series on the study of countercurrent gas centrifugation for the isotopic separation of U. The basic equations for the separation of binary mixtures in continuous process apparatus are developed and the analytical relations of perfect and actual cascades are derived. The concepts of separation potential and separation work are revised and illustrated with practical examples. (tr-auth)

9037 CANADIF: BOURASSA'S NATIONALISTIC DREAM COULD BECOME A NIGHTMARE. Carruthers, J. Sci. Forum; 8: No. 2, 3-6(Apr 1975).

Construction of a plant for the enrichment of uranium intended for export in the James Bay region of Quebec seems unlikely because of several disadvantages associated with the scheme. Among these are the fact that the plant would use much needed hydroelectric power for its operation, the uncertainty of raw uranium supply, and the safeguard problems associated with the export of enriched uranium. In addition, there are no immediate plans for the use of a CANDU reactor system modified to use enriched fuel. (CA)

Isotopic Power Sources

Refer also to abstracts 8752–8758.

9038 (BNWL-1085(SUPPL.)) PACIFIC NORTHWEST LABORATORY DIVISION OF ISOTOPE DEVELOPMENT PROGRAMS QUARTERLY REPORT, FEBRUARY–APRIL 1969: SUPPLEMENT. Sheely, W. F. (ed.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1969. Contract AT (45-1)-1830. 22p. Dep. NTIS $4.25.

Declassified 29 Aug 1969.

Progress during Feb. to May 1969 in testing the compatability of Pm_2O_3 and Pm metal with numerous fuel capsule materials is reported. (LCL)

9039 (SC-DC-65-1677) STUDY OF THE ECONOMICS AND CONSEQUENCES OF RECOVERY OF RADIOISOTOPE FUEL FORMS FROM SPACE SYSTEMS. (Hittman Associates, Inc., Baltimore, Md. (USA)). Aug 1965. Contract AT(29-1)-789. 61p. Dep. NTIS $6.25.

Declassified 7 Sep 1973. For Sandia Corp., Albuquerque, NM.

The recovery of radioisotope fuel from space power systems from the standpoint of economics is evaluated. In addition, the effect of recovery on fuel production and availability is considered. The isotopes considered include ^{239}Pu, ^{210}Po, ^{147}Pm, and ^{244}Cm. (TFD)

9040 (SC-PR-67-2985) AEROSPACE NUCLEAR SAFETY REPORT FOR NOVEMBER 1967. Illing, R. G. (comp.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1967. 29p. Dep. NTIS $4.50.

Declassified 23 Jun 1972.

A letter was sent to the AEC Safety Branch in which the probabilities of the SNAP-19 intact reentry heat source (IRHD) impacting in various areas, countries, and the larger cities of the world were estimated. Three graphite heat shield assemblies were subjected to internal hydrostatic burst tests. The reentry thermal analysis of the SNAP-19 and the IRHS was completed. Martin and Sandia agreed that the 0.30D chamferred ends of the SNAP-19 IRHS could cause serious dynamic problems; two modified con-

figurations will be investigated. A preliminary probability network was developed in relation to potential SNAP-27 mission hazards. Tests to determine the catalytic effect of $^{238}PuO_2$ are being conducted in the Sandia 40-kW hyperthermal arc tunnel. Seven successful ablation experiments were conducted in the ACDRL free-flight gun range using gold microspheres; laser photographs and good impact data were obtained. Representatives of the SEPO Safety Branch, Sandia, and ALO met at ALO on November 9 to discuss the status of the AEC meeting on the search, detection, and recovery of radioisotope heat sources; invitations are being sent to prospective participants and attendees by AEC Headquarters. (TFD)

9041 (SC-PR-68-409) AEROSPACE NUCLEAR SAFETY REPORT FOR MAY 1968. Burke, E. R.; Illing, R. G. (comps.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1968. 29p. Dep. NTIS $4.50.

Declassified 23 Jun 1972.

An analysis was performed to determine the steady-state temperature of the SNAP-19 generator when it is enclosed in an 80-gal drum following recovery of the generator from the ocean. Several live fuel impact tests and a radiant heat test on a verification capsule were completed for SNAP-27. A detailed review of the Martin Preliminary Safety Analysis Report was completed for SNAP-29. Comments were provided to Martin and other concerned organizations. A report documenting the January 1968 AEC meeting on tracking, search, detection, and recovery of nuclear heat sources was distributed. Some results from experimental alpha dosimetry work on ^{238}Pu microspheres are reported; in most cases the results compared favorably with theoretical predictions. Summary information on a study of atmospheric diffusion models for the release of ^{210}Po at high altitude is given, and some preliminary results from Colorado State University on the transfer of ^{210}Po from rumen to milk in dairy cows are reported. (auth)

9042 (SC-PR-68-640) AEROSPACE NUCLEAR SAFETY REPORT, AUGUST 1968. Illing, R. G. (comp.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1968. 32p. Dep. NTIS $4.75.

Research, development, support, and test activities in the Sandia Laboratories Aerospace Nuclear Safety Program for Aug. 1968 are reported. Topics discussed include SNAP-19 filter tests; SNAP-27 safety analysis report, radiant heat test, line fuel impact tests, fragmentation tests, gun projectile impact testing, GLFC explosive overpressure test; SNAP-29 launch area population information, reenterable intact generator; PuO_2 microsphere bonding; intact heat source soil studies, and burial test analysis; aerial detection of a hypothetical ^{60}Co fueled RTG; and estimated dose rates from ^{60}Co fueled RTG at various depths of earth penetration. (TFD)

9043 (TE-4190-80-75) ADVANCED THERMIONIC TECHNOLOGY, FY 1975. Progress Report No. 7. (Thermo Electron Corp., Waltham, Mass. (USA)). Jan 1975. Contract AT(11-1)-3056. 22p. Dep. NTIS $4.25.

Research progress on the program for Jan. 1975 is summarized. Topics discussed include analysis of low work function surfaces, system studies on ^{90}Sr-fueled terrestrial thermionic generators, research converter experiments, and hot shell evaluation. (TFD)

9044 (TID/SNM-27) PROGRAM TO DESIGN AN ADVANCED TECHNOLOGY THERMOELECTRIC MODULE FOR A 2 KW POWER SYSTEM AND TO FABRICATE AND TEST A HEAT PIPE/THERMOELECTRIC MODULE. (Minnesota Mining and Mfg. Co., St. Paul (USA). Electrical Products Group). 29 Jul 1970. 25p. Dep. NTIS $4.25.

A proposal, submitted to the Oak Ridge National Laboratory by the 3M Company, to design, fabricate, test, and deliver a thermoelectric/heat pipe module is presented. The module design is consistent with the general objectives of the 2 kW(e) radioisotope power system program. (TFD)

9045 (TID/SNM-28) TESTING OF THE SNAP-27 TEN-COUPLE MODULES. Stapfer, G. (California Inst. of Tech., Pasadena (USA)). 19 Aug 1969. 30p. Dep. NTIS $4.50.

The life and performance testing of two thermoelectric modules is described. The two identical modules consist of ten lead-telluride thermoelectric couples of 3P-3N type material. The modules were manufactured and procured from the 3M Company. The construction of the module is of the SNAP-27 type technology, and a combined operating time of 27,000 h has been recorded. The thermoelectric elements, the module construction, and the test equipment utilized for the life and performance test are described. The recorded data is then discussed and analyzed. The output power degradation rate of module No. 1 was found to be 0.3%/1000 h for the initial 16,000 h of operation, at which time the degradation rate increased to 3.12%/1000 h. It is postulated, that the decrease of the internal argon pressure is responsible for the increased degradation rate of module No. 1. An increase of internal resistance was found to be responsible for both modules overall output power decrease. (auth)

9046 HEAT SOURCE CONTAINING RADIOACTIVE NUCLEAR WASTE. Busey, H. M. (to U. S. Atomic Energy Commission). US Patent 3,866,424. F03g7/06; F01k27/00. 18 Feb 1975. Filed date 3 May 1974. 7p.

PAT-APPL-466,770.

A heat source is described that includes packages or cans of radioactive heat-producing nuclear waste material contained in vertically disposed heating tubes immediately surrounded and cooled by a "spare" coolant at its boiling temperature which in turn is surrounded by a "primary" coolant from which useful heat is extracted. Immediately above the primary coolant chamber is an emergency coolant chamber which cools vapors of the boiling liquid when an increase in heat caused by interruption of primary cooling causes an increase in the temperature of the boiling liquid so that vapors therefrom rise into a zone cooled by the emergency coolant. Heat pipes having a portion in thermal contact with the top of heating tubes and a portion exposed to the atmosphere are provided as also are fused which permit the radioactive material to drop into a canal beneath the normal heat source zone should all other means for removing heat fail. (auth)

9047 RADIONUCLIDE BATTERIES. P. 2. Characteristics and uses. Schalch, D.; Scharmann, A. (Giessen Univ. (F. R. Germany). 1. Physikalisches Inst.); Euler, K. J. (Gesamthochschule Kassel (F. R. Germany)). Kerntechnik; 17: No. 2, 57-73(Feb 1975). (In English, German).

Radionuclide batteries are long-lived compact sources of electric power, requiring extremely little maintenance. They are used to a certain extent in special areas of engineering where power supply by conventional means is too expensive or impossible, e.g., in space engineering, in some areas of marine and of telecommunication engineering, in meteorology and in medicine. Characteristic data of radionuclide batteries, their special uses, and associated safety problems are reported. (auth)

Radiation Sources

9048 LOSS OF FIELD FLATNESS IN AECL TELETHERAPY UNITS FROM MISADJUSTMENT OF THE COLLIMATOR. Heintz, P.H. (Radiation Therapy Center of Sutter Community Hospitals, Sacramento, California 95816). Med. Phys. 2: No. 2, 76-78 (Mar 1975).

Atomic Energy of Canada Limited ^{60}Co teletherapy units have adjustable collimator hinges to adapt to source diameters from 0.75 to 2.50 cm. Adjustment of the collimator hinge to the manufacturer's settings can cause a loss of radiation field flatness as high as 20% for large fields. The recommended settings appear to clip the top corners of tall source capsules. Opening the hinge adjustment restores field flatness, without changing penumbra or the inverse square law behavior of the teletherapy unit. (auth)

Design and Fabrication

Refer also to abstract 10804.

9049 FREEZE DRYING METHOD FOR PREPARING RADIATION SOURCE MATERIAL. Mosley, W. C. Jr.; Smith, P. K. (to U.S. Atomic Energy Commission). US Patent 3,873,651. G21c21/00. 25 Mar 1975. Filed date 12 May 1972. 6p.

PAT-APPL-252,643.

A solution containing radioisotope and palladium values is atomized into an air flow entering a cryogenically cooled chamber where the solution is deposited on the chamber walls as a thin layer of frozen material. The solvent portion of the frozen material is sublimated into a cold trap by elevating the temperature within the chamber while withdrawing solvent vapors. The residual crystals are heated to provide a uniformly mixed powder of palladium metal and a refractory radioisotope compound. The powder is thereafter consolidated into a pellet and further shaped into rod, wire or sheet form for easy apportionment into individual radiation sources. (auth)

Industrial Uses

Refer also to abstracts 9093 and 9104.

9050 (BNWL-1902) LIST OF ERDA RADIOISOTOPE CUSTOMERS WITH SUMMARY OF RADIOISOTOPE SHIPMENTS, FY-1974. Simmons, J. L.; Mandell, S. (comps.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-1830. 38p. Dep. NTIS $4.00.

The eleventh edition of the AEC radioisotope customer list has been prepared at the request of the Division of Biomedical and Environmental Research. The purpose of this document is to list the FY 1974 commercial radioisotope production and distribution

activities of USAEC facilities at Argonne National Laboratory, Battelle, Pacific Northwest Laboratories, Brookhaven National Laboratory, United Nuclear Inc., Idaho Operations Office, Hanford Engineering Development Laboratory, Mound Laboratory, Oak Ridge National Laboratory, and Savannah River Plant. The information is divided into four sections. Section I is an alphabetical list of domestic and foreign customers and their addresses. Each customer has been designated a number according to its alphabetical position which provides a means of cross-referencing in the following sections. The isotopes purchased are listed after the address of the customer and the laboratory supplying each isotope is indicated by a letter set off by parentheses. Section II is an alphabetical list of isotopes, cross-referenced to customer numbers and again divided into the domestic and foreign categories. This section provides a quick idea of the amount of companies purchasing a particular isotope. If more information is needed, the reader can locate the customer by number and determine the laboratory supplying the isotope. The third section is an alphabetical list of states and countries, also cross-referenced to customer numbers, indicating geographical concentrations of isotope users. Section IV summarizes the FY 1974 radioisotope shipment activities of USAEC laboratories in a comprehensive table providing an alphabetical listing of the isotopes and their suppliers. (auth)

9051 (EURISOTOP-88) RADIOMETRIC INDUSTRY OF THE COMMON MARKET COUNTRIES. Roeper, B. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). Dec 1974. 298p. (In German). Dep. NTIS (US Sales Only) $18.00.

A comprehensive review is given of the development and growth of the radiometric industry of the Common Market countries. The topics considered are the development of radioisotope economy since 1960, use of radiometric methods in Europe and in the USA up to 1970, present applications of radiometric methods in Common Market countries, foreign trade in radiometric instruments, structure of the radiometric industry, manufacturers of radiometric instruments in the Common Market, competition with the USA, and future needs for radiometric instruments. (JSR)

9052 RADIOACTIVE TRACER METHOD FOR INVESTIGATION OF METAL CORROSION. A Literature Survey. Madi, I. (Kossuth Lajos Tudomanyegyetem, Debrecen, Hungary). Izotoptechnika.; 18: No. 3, 126-131(Mar 1975). (In Hungarian).

A literature survey on radiotracer methods for studying the corrosion of metals is presented. (auth)

9053 RADIOISOTOPES IN INDUSTRY. Rajput, M. S. (Punjab Univ., Chandigarh, India). Sci. Rep. (India).; 9: No. 12, 575-579(Dec 1972).

Industrial uses of radioisotopes are described and illustrated. Two main applications of radioisotopes are for use as tracers and as radiation sources. Tracer techniques enables the study of the chemical behavior of an element or its pathway in a chemical reaction or biological system. Radioisotopes used as radiation sources serve in the study of radiation effects on materials used in industry, in nondestructive testing of materials and in sterilizing food products, etc. Measurements are based on the penetration power of the radiations (α or β particles) or backscattering of the radiations or ionization caused by these radiations. Design and operation of such instruments for measuring thickness, coating thickness, gas pressure, fluid level, and flaw detection are briefly outlined. (INIS)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 8542 and 9106.

9054 (BNWL-1950(Pt. 1), pp 165-166) FREE-RADICAL DAMAGE TO MAMMALIAN ERYTHROCYTES. Kalkwarf, D. R.; Felix, W. D. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I, Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Free radicals derived from irradiated crystals of L-serine hemolyzed canine erythrocytes, while radicals derived from irradiated glucose did not. These results further confirm the hypothesis that radicals capable of reducing flavin mononucleotide are also capable of hemolyzing erythrocytes. (auth)

9055 (BNWL-1950(Pt. 1), pp 167-168) FREE-RADICAL INACTIVATION OF MUSCLE ALDOLASE. Felix, W. D.; Kalkwarf, D. R. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I, Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Rabbit muscle aldolase has been shown to be deactivated by addition of irradiated crystals of various sugars and amino acids. Inactivation observed immediately upon dissolution is ascribed to reaction with free radicals, whereas post-dissolution inactivation is ascribed to acid-catalyzed reaction with nonradical radiolysis products. (auth)

9056 (UCB-34P190X3) PROGRESS REPORT. Linn, S. M. (California Univ., Berkeley (USA). Dept. of Biochemistry). 1974. Contract AT(04-4)-34. 3p. Dep. NTIS $4.00.

Progress is reported on the following research projects: effects of the rec BC enzyme on DNA molecules; inhibition of the rec BC enzyme by γ-protein from bacteriophage λ; ATP-independent endonuclease activity in Salmonella typhimurium; purification of endonuclease from Escherichia coli; and excision repair of DNA treated with MMS and uv-irradiated DNA. (HLW)

9057 POSTREPLICATION DNA REPAIR IN ULTRAVIOLET-IRRADIATED MICROCOCCUS LUTEUS. Zherebtsov, S. V.; Tomilin, N. V. (Academy of Sciences of USSR, Leningrad). Biochim. Biophys. Acta; 383: No. 1, 16-22(24 Feb 1975).

Postreplication DNA repair was studied in three strains of Micrococcus luteus having different sensitivity to ultraviolet light: a wild type ATCC 4698, an ultraviolet-sensitive mutant G7, deficient in the incision step of repair and in ultraviolet-resistant transformant obtained from G7 by treatment with DNA of wild type cells, Trf(G7). It is shown that the G7 mutant has a low capacity for repair of postreplication DNA gaps compared with the wild type of Trf(G7). It seems to be that postreplication repair capacity contributes significantly to the ultraviolet resistance of M. luteus in addition to the excision repair. In contrast with G7, the size of the DNA fragments synthesized immediately after ultraviolet irradiation in the wild type (and Trf(G7)) seems to be much higher than that expected if each dimer produces one DNA gap in the daughter strand. Since this cannot be explained only by the excision of dimers from parental DNA we have suggested that a rapid repair of postreplication DNA gaps occurs in M. luteus. (NL)

9058 STUDIES ON A DNA PHOTOREACTIVATING ENZYME FROM STREPTOMYCES GRISEUS. II. Purification of the Enzyme. Eker, A. P. M.; Fichtinger-Schepman, A. M. J. (Technische Hogeschool, Delft, Netherlands). Biochim. Biophys. Acta; 378: No. 1, 54-63(6 Jan 1975).

A procedure is described for the isolation of a DNA photoreactivating enzyme from Streptomyces griseus. Application of chromatography on spherosil, ultraviolet-irradiated DNA–cellulose, DEAE-cellulose, and single stranded-DNA-agarose resulted in a 22,000-fold purification with 46% recovery on the initial activity. According to polyacrylamide gel electrophoresis the final preparation was virtually homogeneous. The chemical preparation of column packings is described. (NL)

9059 DEOXYRIBONUCLEIC ACID SYNTHESIS INDUCED WITH ULTRAVIOLET LIGHT IN BRIJ 58-TREATED BACILLUS SUBTILIS SPORES GERMINATED IN THE PRESENCE OF CHLORAMPHENICOL. Fujita, Y.;Tohru, K. (Kyoto Univ.). Biochim. Biophys. Acta; 378: No. 1, 35-43(Jan 1975).

The direct measurement of ultraviolet light-stimulated DNA synthesis in the permeable Bacillus subtilis cells was performed. Bacillus subtilis spores germinated in the presence of chloramphenicol were treated with Brij 58 and irradiated with ultraviolet light, and [^{3}H]dTTP was incorporated into these cells by the DNA polymerase assay system. Characteristics of the incorporation were distinct from those into spores germinated in the absence of chloramphenicol and treated with Brij 58, in the respect that the former incorporation did not require ATP and only partially depended on the presence of all four deoxyribonucleoside triphosphates. The incorporation of [^{3}H]dTTP into DNA was confirmed by CsCl density gradient centrifugation. A DNA polymerase I-deficient strain, JB1 49(59) had no [^{3}H]dTTP incorporating activity induced by ultraviolet light irradiation when the germinated spores were treated with Brij 58. Analysis of alkaline sucrose gradient centrifugation revealed that fragmented DNA caused by ultraviolet light irradiation was rejoined to the size of DNA of non-irradiated cells by incubating irradiated cells in the DNA polymerase assay mixture containing NAD^+. The results also suggested that a machinery of DNA repair probably pre-existed in the spore. (NL)

9060 UV DOSE-DEPENDENT INDUCTION OF ENZYMES RELATED TO FLAVONOID BIOSYNTHESIS IN CELL SUSPENSION CULTURES OF PARSLEY. Wellmann, E. [Freiburg i. B. Univ.). FEBS (Fed. Eur. Biochem. Soc.) Lett.; 51: No. 1, 105-107(Mar 1975).

Description of the uv dose-dependent synthesis of flavonoids in seven-day-old cell suspension cultures of Petroselinum hortense. The linear uv-dose dependence, as found points to a sequence of linearly-related metabolic reactions, translating the stimulus induced by a certain amount of uv quanta into a proportional number of flavonoid molecules. This linear relationship can also be assumed to represent an efficient protection mechanism against a surplus of damaging solar uv radiation, which then could be absorbed by the flavonoid pigments accumulated in the outer cell layers of the plant. The change in activity of the related enzyme phenylalanine ammonia-lyase (PAL) was also studied. (NL)

9061 SYNERGISM BETWEEN DIFFERENT NEAR-ULTRAVIOLET WAVELENGTHS IN THE INACTIVATION OF TRANSFORMING DNA. Peak, M. J.; Peak, J. G.; Webb, R. B. (Argonne National Lab., IL). Photochem. Photobiol.; 21: No. 2, 129-131 (Feb 1975).

Instances where the effects of one type of radiation modified the effects of another type are well known. The possibility of synergism between the effects of different monochromatic wavelengths of the near uv on transforming DNA has been investigated. The results demonstrated synergism by 334 and 313 nm radiation in the inactivation of DNA by 365 nm radiation; either pre-irradiation or concomitant irradiation at 334 nm could produce a synergistic inactivation at 365 nm uv. Suggestions are made for possible mechanisms of these synergisms, and the implications for studies involving the use of broad spectrum uv lamps are pointed out. The results have also demonstrated that low dose rates at some ultraviolet wavelengths could have major biological effects. (UK)

9062 ELECTRON TRANSFER IN PHOTOSENSITIZATION OF BIOMOLECULES BY ACRIDINE DYES. Van de Vorst, A.; Lion, Y. (Univ., Liege). Photochem. Photobiol.; 21: No. 2, 85-89(Feb 1975).

The photosensitization of some biomolecules by proflavine was studied using the technique of electron paramagnetic resonance. It was shown that this process was directly influenced by the relative molar concentration of dye and substrate. For some values of these concentrations, a singlet associated with a radical form of proflavine was observed. The appearance of this signal is discussed in terms of electron transfer from an ionized proflavine molecule directly to another neutral dye molecule or via a molecule of substrate as an intermediate. It was shown that this transfer was facilitated by stacking. These results were compared with radiolysis of the same kind of complexes in frozen aqueous solution. (auth)

9063 STUDY OF THE EFFECTS OF ULTRAVIOLET LIGHT ON BIOMEMBRANES. IV. The Effect of Oxygen on Uv-induced Hemolysis and Lipid Photoperoxidation in Rat Erythrocytes and Liposomes. Roshchupkin, D. I.; Pelenitsyn, A. B.; Potapenko, A. Y.; Talitskii, V. V.; Vladimirov, Y. A. (Moscow State Medical Inst.). Photochem. Photobiol.; 21: No. 2, 63-69(Feb 1975).

Hemolysis induced by irradiation with ultraviolet (uv) light at 254 nm showed a pronounced oxygen effect: under irradiation in vacuum, the rate of hemolysis was decreased by an order of magnitude. Irradiation at 254 nm in air but not under vacuum caused the peroxidation of erythrocyte membrane lipids. These results

suggested that membrane lipid photoperoxidation is one of the causative factors of uv hemolysis. Irradiation at different wavelengths showed that uv-induced lipid photoperoxidation in erythrocyte membranes developed while the antioxidant α-tocopherol was directly photooxidized. It was shown that the process of lipid photolysis in erythrocyte membranes involved sensitization, possibly by protoporphyrin, whose presence in liposomes accelerated the photoperoxidation at 254 and 365 nm of unsaturated fatty acid residues in lecithin. Possible mechanisms of photochemical damage to erythrocyte membranes are discussed. (auth)

9064 ROLE OF PHOSPHATE IN THE IRRADIATION OF DNA IN AQUEOUS SOLUTIONS. Lafleur, M. V. M.; Loman, H.; Blok, J. (Vrige Univ., Amsterdam). Int. J. Radiat. Biol.; 27: No. 2, 197-200(Feb 1975).

Phosphate buffers have often been used in studies of the radiation chemistry of DNA in aqueous solution, on the assumption that phosphate ions are inert in the reactions of the primary water radicals and DNA. However phosphate anions react with hydrated electrons giving rise to H radicals, which can inactivate DNA. A comparative study of the radiosensitivities of ϕX174 DNA in phosphate buffer and in solutions of the radiolytically-inert electrolyte sodium chloride, under three different gas conditions (O_2, N_2, and N_2O), was therefore carried out. Replacement of phosphate by sodium chloride had no influence on the radiosensitivity when the DNA was gamma-irradiated under O_2 or N_2O, but under N_2 an increase in the radiosensitivity by a factor of about 1.8 was observed. An explanation is offered for the variations in D_{37} values under these different conditions. Phosphate is therefore not an ideal buffer for the study of reactions of all the primary water radicals with DNA. However, for the study of reactions of H radicals, in particular with DNA, the phosphate buffer can be suitable since it converts e^-_{aq} into H radicals in neutral solutions. (UK)

9065 ACTION SPECTRUM FOR THE OXYGEN-INDEPENDENT INACTIVATION OF HAEMOPHILUS INFLUENZAE TRANSFORMING DNA WITH NEAR ULTRA-VIOLET LIGHT. Cabrera-Juarez, E.; Swenson, P. A. (Instituto Politecnico Nacional, Mexico City). Photochem. Photobiol.; 21: No. 3, 193-195(Mar 1975).

The oxygen-independent inactivation of Haemophilis influenzae transforming DNA by near uv light (300 to 380 nm) had an action spectrum in which the efficiency of inactivation dropped rapidly between 313 and 334 nm and more slowly between 334 and 405 nm, with a shoulder between 334 and 365 nm. (auth)

9066 ROLE OF THE ATTACHMENT OF DNA TO THE MEMBRANE IN THE REPAIR OF RADIOLESIONS IN MICROCOCCUS RADIODURANS. Dardalhan-Samsonoff, M.; Rebeyrotte, N. (Institut de Radium, Paris). Int. J. Radiat. Biol.; 27: No. 2, 157-169(Feb 1975).

The unirradiated bacterial DNA associated with the membrane was liberated into the cytoplasm after breakage of either a single or a double strand, resulting from x-ray action. During the reincubation period in growth-medium, the DNA was reassociated with the membrane. This phenomenon was very rapid and occurred without increasing the molecular weight of DNA. The study of DNA-membrane complexes showed that the size of the DNA-associated membranous fragment differed according to the lysing technique employed, appearing as a change in the density of the complex. Chloramphenicol decreased reassociation, and iodoacetamide, a radiosensitizing agent, inhibited it completely. (auth)

9067 REPAIR OF RADIATION-INDUCED STRAND BREAKS AS RELATED TO THE INDUCIBLE INHIBITOR OF POSTIRRADIATION DNA DEGRADATION. Tolun, A.; Christensen, R.; Pollard, E. C. (Pennsylvania State Univ., University Park). Biophys. J.; 14: No. 9, 691-696(Sep 1974).

The repair of radiation-produced single-strand breaks observed under alkaline conditions is very apparent in cells which possess an inducible inhibitor of postirradiation DNA degradation. Previous induction of the inhibitor with ultraviolet light increases the amount of repair. In those cells which are genetically not inducible there is no increase following ultraviolet irradiation. (auth)

9068 REPAIRABLE AND NONREPAIRABLE INACTIVATION OF IRRADIATED AQUEOUS PAPAIN: EFFECT OF OH, O_2^-, e/sub aq$^-$/, AND H_2O_2. Lin, W. S.; Clement, J. R.; Gaucher, G. M.; Armstrong, D. A. (Univ. of Calgary, Alberta). Radiat. Res.; 62: No. 3, 438-455(Jun 1975).

Repairable inactivation of papain irradiated in dilute aqueous solutions saturated with air or nitrous oxide is caused predominantly by reversible oxidation of $Cys_{25}SH$ by H_2O_2. The same process occurs in nitrogen-saturated solutions but the yield of repairable product decreases at higher doses, probably because of the consumption of H_2O_2 by intermediates formed from e$^-$/sub aq/ and papain. The OH radical produces only nonrepairable damage, with the fraction of the OH radical causing nonrepairable inactivation (f/sub OH//sup n.r./) equal to 0.1 and this is accompanied by, if not solely due to, SH loss. The O_2^- radical with f/sub O_2//sup -n.r./ equals 0.4 also causes nonrepairable damage resulting from or accompanied by SH loss. In addition, there is evidence that every O_2^- reacts with papain to produce a hydrogen peroxide molecule, thus causing a marked increase in the repairable yield. The solvated electron for which f/sub e//sup n.r./ is 0.07 does not appear to destroy $Cys_{25}SH$, and must, therefore, inactivate papain by damaging other essential residues or changing the active site geometry. The inactivation yields for the present papain solutions prepared by affinity chromatography are compared with other work. Discrepancies in previous determinations of sulfhydryl loss are attributed to the special properties of the sulfenic acid product of the H_2O_2-papain reaction and its different effects on pHMB and DTNB assays. (auth)

9069 EFFECTS OF METAL IONS ON THE FORMATION OF RADICALS AND STRAND BREAKS AND ON HYDROGEN TRANSFER IN gamma-IRRADIATED DNA. Kominami, S.; Wee, V. T.; Riesz, P. (National Cancer Inst., Bethesda, MD). Radiat. Res.; 62: No. 3, 422-437(Jun 1975).

The effects of various metal ions (Cd^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, and Cr^{3+}), present at a concentration of 1 metal ion per 100 nucleotides, on the formation of carbon radicals at 77 and at 298^{0}K, on the production of phosphomonoester groups, and on hydrogen transfer in gamma-irradiated DNA in the solid state in vacuo were investigated. Those metal ions that decrease the radical yield at 77 and 298^{0}K (as measured by electron spin resonance) were also effective in decreasing the formation of strand breaks and the transfer of hydrogen from exchangeable to carbon-bound sites. From ESR studies of cupric-DNA complexes, it was inferred that cupric ions compete with the bases in DNA for electrons produced by gamma radiation, thus preventing the formation of anionic radicals at 77^{0}K which are precursors of the stable neutral radicals observed at room temperature. (auth)

9070 ELECTRON-AFFINIC SENSITIZATION. VI. A Pulse Radiolysis and ESR Comparison of Some 2- and 5-Nitroimidazoles. Whillans, D. W.; Adams, G. E. (Mount Vernon Hospital, Northwood, Eng.). Radiat. Res.; 62: No. 3, 407-421(Jun 1975).

The nitroimidazoles are effective radiosensitizers for both hypoxic bacterial and mammalian cells and are currently under clinical investigation as adjuncts in radiotherapy. It is known that the 2-nitroimidazoles are biologically more efficient than the 5-nitro derivatives. Some aspects of the radiation chemistry of one biologically important example of each class, together with results obtained with other related derivatives, are reported. Metronidazole (a 5-nitroimidazole) and Ro-07-0582 (a 2-nitroimidazole) react rapidly with both e$^-$/sub aq/ and OH to produce transient absorbing species, which decay by second-order kinetics. Both compounds accept electrons from the radical anion of thymine at near diffusion-controlled rates, but not from neutral thymine radicals formed by H and OH attack. From a study of one-electron transfer reactions involving p-nitroacetophenone as an electron acceptor it is shown that the electron affinity of the 2-nitroimidazole structure is higher than that of the 5-nitroderivatives and similar to that of PNAP. Further, ESR studies of these radical anions indicate greater resonance stabilization of 2-nitroimidazoles, implying a higher electron affinity. This correlates with the greater biological effectiveness of the 2-nitroimidazoles as hypoxic cell radiosensitizers. (auth)

9071 ELECTRON SPIN RESONANCE STUDIES OF ELECTRON-IRRADIATED PEPTIDES. A Single Crystal of N-Acetyl-L-Cysteine at 77 K. Saxebol, G.; Herskedal, O. (Univ. of Oslo). Radiat. Res.; 62: No. 3, 395-406(Jun 1975).

Radioinduced radicals in single crystals of N-acetyl-L-cysteine were studied with ESR spectroscopy. Two different types of radicals were observed. One of these species was identified as a sulfur radical of the type $RCH_2S\cdot$ with principal g values; g_1 equals 2.214, g_2 equals 2.006, and g_3 equals 1.990. The isotropic hyperfine splitting from the two beta-protons were found to be 22.1 and 29.4 G. The sulfur radical was stable at room temperature. However, temperature-broadening effects make it difficult to detect these sulfur radicals at 300^{0}K. The other radical induced at 77^{0}K seems to be the radical product formed by a decarboxylation process. (auth)

9072 APYRIMIDINIC SITES IN GAMMA-IRRADIATED DNA. Dunlap, B.; Cerutti, P. (Florida Univ., Gainesville). FEBS (Fed. Eur. Biochem. Soc.) Lett.; 51: No. 1, 188-190(1 Mar 1975).

9073 EFFECT OF HEAVY WATER (D_2O) ON THE STABILITY OF PROCOLLAGEN TO THERMAL DENATURATION AND TO THE EFFECT OF COLLAGENASE. Aleksandrov, V. Ya.;

Vitvitskii, V. N.; Levdikova, G. A. (Botanical Inst., Moscow). Dokl. Akad. Nauk SSSR; 220: No. 6, 1445-1448(21 Feb 1975). (In Russian).

The change in stability of a protein to thermal denaturation and to the hydrolytic action of a proteinase may serve as an indirect indicator of a change in conformational flexibility of a protein molecule. The thermal denaturation temperature was determined in a thermostated, Ostwald viscosimeter. It was found that the thermal denaturation of procollagen dissolved in heavy water starts at a higher temperature than that of procollagen dissolved in ordinary water. Moreover, a comparative study of the rates of enzyme splitting of procollagen by procollagenase showed that procollagen dissolved in heavy water hydrolyzes more slowly than that dissolved in ordinary water. (SJR)

9074 DETECTION OF RADIATION DAMAGE TO SECONDARY DNA STRUCTURES IN COTTON BY FRACTIONATION ON HYDROXYAPATITE. Arindzhanov, Sh. A. (Inst. of Biochemistry, Tashkent). Uzb. Biol. Zh.; No. 1, 71-72(1975). (In Russian).

Data on the increase in the fraction of denatured DNA with increasing radiation dose indicated that irradiation causes formation of DNA molecules with evident denaturation changes. However, the DNA keeps its secondary structure and is eluted like the native molecules. The data confirm the radiation sensitivity of AT-pair nucleotides and formation of GC-pair saturated fragments as a result of radiation damage. (TTT)

9075 EFFECT OF ULTRAVIOLET (UV) LIGHT ON THE CATALYTIC PROPERTIES OF MEMBRANE Ca^{2+}-ATPase FROM HUMAN ERYTHROCYTES. Volotovskii, I. D.; Vol'f, G.; Doze, K. (Inst. of Photobiology, Minsk). Dokl. Akad. Nauk SSSR; 220: No. 6, 1449-1452(21 Feb 1975). (In Russian).

Ultraviolet light has a strong, inhibiting effect on proteins. Erythrocyte fractions obtained by the method of Wolf were subjected to uv-light irradiated from a xenon lamp. The change of inorganic phosphate in the system was followed by a special photometric setup. The enzyme activity was estimated from the change in pH as a result of ATP hydrolysis. The erythrocyte irradiation with uv-light was accompanied by inactivation of membrane Ca^{2+}-ATPase. The inactivation obeys a first-order kinetics. At the same time the photosensitivity of the Ca^{2+}-ATPase apparently depends on the lipid environment, and the structural state of the erythrocytic membrane. (SJR)

9076 EFFECT OF THE POWER SATURATION OF MICROWAVE FIELD FOR PARAMAGNETIC CENTRES OF UV-IRRADIATED PROTEINS. Aripov, T. F.; Aripova, D. F.; L'vov, K. M. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki; AN SSSR, Pushchino-na-Oke. Inst. Biologicheskoj Fiziki). Biofizika; 19: No. 3, 440-442(May 1974). (In Russian).

For English translation see the journal Biophysics.

It is known that paramagnetic centers of various types occur in proteins on irradiation with ultraviolet light. On studying the nature of these paramagnetic centers and their reactions by electron paramagnetic resonance (EPR) it is necessary to take into account the effect of power saturation in the EPR absorption. This study considers the effect of saturation for various paramagnetic centers of proteins irradiated with ultraviolet light. (tr-INIS)

Radiation Effects on Cells

Refer also to abstracts 9091–9092, 9148, and 10597.

9077 (BNWL-1950(Pt. 1), pp 153-155) COORDINATE REGULATION OF THE EXOCELLULAR PROTEASES IN NEUROSPORA CRASSA. Cohen, B.; Morris, J. E.; Drucker, H. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I, Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

When cells of N. crassa are starved for nitrogen, sulfur, or carbon and energy, and protein is sole source of these nutrilites, specific inhibition studies, electrophoresis and immunological assays suggest that at least two of the exocellular proteases synthesized (an alkaline and a neutral protease) in response to these conditions are the same, regardless of limiting nutrilite. This implies a coordinate regulation of these enzymes. (auth)

9078 (BNWL-1950(Pt. 1), pp 160-161) ROLE OF THE CELL MEMBRANE IN VOLUME REGULATION. Schneider, R. P. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I, Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The mechanism for the stimulation of Na^+ efflux in swollen cells was studied in red cells with increased and decreased cell volume. Results suggest that this response is the result of an increased affinity of the system for Na^+ caused by reduced inhibition by intracellular K^+ resulting from simple dilution during swelling, and a direct effect of membrane stretching on conformation of the transport system. (auth)

9079 (COO-3335-23) MOLECULAR EVENTS BASIC TO CELLULAR RADIATION RESPONSE. Progress Report. Koiodny, G. M. (Massachusetts General Hospital, Boston (USA). Radiology Research Lab.). 1974. Contract AT(11-1)-3335. 123p. Dep. NTIS $9.25.

Work during the past year has been focused on three areas related to the cellular effects of radiation. Radiation effects on RNA and the regulation of gene expression and amino acid-nucleic acid interactions were studied. Studies on the radiation response of RNA in growing and confluent cells were continued. We have derived radiation survival curves and demonstrated repair of potentially lethal damage in 3T3 cells. Studies of giant cell formation and turnover of ribosomal RNA in irradiated cells has demonstrated differences in growing and confluent cells. We have sought evidence consistent with our hypothesis for regulation of eukaryotic gene expression with segments of RNA reutilized to prime new RNA synthesis. Data derived from the turnover of ribosomal RNA and the methylation pattern of ribosomal RNA during turnover are consistent with the possibility that a segment of 18s ribosomal RNA is being conserved during new RNA synthesis. We were unable to show reutilization of the 5' trinucleotide of 18s and 28s ribosomal RNA but did find a ribonuclease resistant oligonucleotide in 18s RNA which appeared to be reutilized. In studies of amino acid nucleic-acid interactions using nuclear magnetic resonance spectroscopy we have been able to successfully synthesize an amidate and begin an examination of the intramolecular interactions. We have also studied intermolecular interactions between tryptophan and nucleoside monophosphates and found upfield shifts which provide evidence for preferential stacking of the 6-membered ring of tryptophan with adenine and evidence for specific geometry of interactions of tryptophan with cytosine. (auth)

9080 (UCRL-75285) FLOW SYSTEMS CELL ANALYSIS AND SORTING. Van Dilla, M. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Dec 1973. 10p. (CONF-731007-8). Dep. NTIS $4.00.

From 1st symposium on mammalian cells: probes and problems; Los Alamos, New Mexico, USA (17 Oct 1973).

The usefulness and wide applicability of Coulter counting and volume spectrometry led to a reexamination of optical methods including not only scattering but also absorption and fluorescence of stained and unstained cells. This led to the development of flow microfluorometry in essentially parallel and independent efforts, which are reviewed. Various approaches to cell sensing developed led to the development of various cell sorting systems. Biological applications are the real motivation for all these developments, and these have proliferated in such fields as life-cycle analysis of cell populations, studies of leukocytes and leukemia, mechanism of the immune response, studies of transformation and tumor cells, effects of radiation and drugs on cell cycle traverse, cell surface studies, and attempts to automate screening of exfoliative cytology material for cancer cells. Current technological developments and biological applications are considered. (HLW)

9081 MECHANISTIC STATE VECTOR MODEL FOR THE INTERACTION OF IONIZING RADIATION WITH CELLS. Scott, B. R. Urbana, IL; Univ. of Illinois (1974). 100p. University Microfilms Order No. 75-11,550.

Thesis (Ph. D.).

A mechanistic state vector model (MSV model) has been developed to describe the interaction of ionizing radiation with cells and the consequences thereof. The MSV model considers the multifactored, nonlinear, and probabilistic nature of the interacting processes. The model is kinetic in nature and considers intracellular transitions involving the production, correction, and confirmation of radiation induced damage. Some important implications of the MSV model for systems irradiated at constant dose rates are as follows: Systems that accumulate sublethal damage should show an increasing cellular mortality rate with increasing dose of low LET radiation, if the efficiency of the radiation in killing cells increases as the amount of sublethal damage increases. However, for some cases of high LET irradiations, the cellular mortality rate may decrease with increasing dose. The shape of a radiation dose-response survival curve is determined by the cellular mortality rate profile. The absence of a shoulder in a dose-response survival curve is not necessarily an indication that repair machinery is inoperative, but is a consequence of an invariant cellular mortality rate. The extrapolation number, D/sub q/, and D/sub O/ may be dose-rate dependent in some

cases. Increasing the dose rate may in some cases afford a dose sparing effect. Target-hit models are in fact special cases of a more general kinetic model. Purely dose-dependent target-hit models can not account for dose rate effects, especially at low dose rates; nor can they account for post irradiation transitions. (Diss. Abstr. Int. B)

9082 REPAIR OF POTENTIALLY LETHAL RADIATION DAMAGE IN MAMMALIAN CELLS IS ASSOCIATED WITH ENHANCEMENT OF MALIGNANT TRANSFORMATION. Terzaghi, M.; Little, J. B. (Harvard School of Public Health, Boston). Nature(London).; 253: No. 5492, 548-549(13 Feb 1975).

It is stated that recent evidence has shown that important repair processes, reflected by marked enhancement in survival, when subculture of cells was delayed after x irradiation, may occur in density inhibited cells during the first few hours after treatment. A study is here described on the dynamics of transformation during this interval and on changes in survival and transformation frequency, with a view to gaining an insight into the interrelationships between repair of potentially lethal lesions and the development or loss of the potential of a cell to become transformed. A C3H mouse embryo-derived cell line was used in the studies. The results agreed with the hypothesis that if there is an interval after treatment, during which a cell does not divide, it will repair lesions that would eventually lead to malignant transformation. Mechanisms are discussed. (UK)

9083 SURVIVAL OF SYNCHRONIZED CHINESE HAMSTER CELLS EXPOSED TO RADIATION OF DIFFERENT LINEAR-ENERGY TRANSFER. Bird, R. P.; Burki, H. J. (Univ. of California, Berkeley). Int. J. Radiat. Biol.; 27: No. 2, 105-120 (Feb 1975).

Chinese hamster V79 cells were exposed to ionizing radiations of a wide range of linear-energy transfer (LET), including 145 kV x rays and six different heavy ions accelerated in the Berkeley heavy-ion linear accelerator. The LET of the ions ranged from 19 keV/μm to 2000 keV/μm. Survival curves were determined for both synchronized and asynchronous cells, using survival of colony-forming capacity as the end-point. Results with asynchronous cultures were similar to results reported previously for mammalian cells. There was increased effectiveness of killing per dose with increased LET until a change in shape of the single-cell survival curves resulted, from sigmoidal to exponential, with carbon ions (LET of 190 keV/μm). With heavier ions, exponential curves were obtained, but with decreased effectiveness per unit dose. Synchronized cultures were obtained by mitotic selection. The expected Chinese hamster cell-cycle survival curve variation was found for x rays, mainly reflecting the variation in the single-cell extrapolation number, with late-S-phase cells the most resistant to radiation. When synchronized cultures were irradiated with the heavy ions that produce exponential survival curves, the survival curves were independent of the cell-cycle time of irradiation. With radiations of LET values between the low and high extremes, a reduced cell-cycle survival curve variation was found, indicating a gradual reduction in the cell-cycle survival curve variation as a function of increased LET. (auth)

9084 AGE-DEPENDENT EXCISION REPAIR OF DAMAGED THYMINE FROM γ-IRRADIATED DNA BY ISOLATED NUCLEI FROM HUMAN FIBROBLASTS. Mattern, M. R.; Cerutti, P. A. (Univ. of Florida, Gainesville). Nature (London).; 254: No. 5499, 450-452(3 Apr 1975).

A study is described on the capacity of isolated nuclei from young, medium-aged and old W1-38 human cells to excise damaged thymine residues of the 5,6-dihydroxydihydrothymine type from exogenous γ-irradiated DNA substrates. The studies included the effect of radiation-induced strand breaks on the repair process. It was found that young and medium-aged nuclei possess the capacity for the selective excision of γ-ray damaged thymine from exogenous DNA. Old nuclei did not cause excision. Comparative studies are also described with OsO_4-oxidised DNA substrates. (UK)

9085 ABSENCE OF ULTRAFAST PROCESSES OF REPAIR OF SINGLE-STRAND BREAKS IN MAMMALIAN DNA. Palcic, B.; Skarsgard, L. D. (British Columbia Univ., Vancouver, Can.). Int. J. Radiat. Biol.; 27: No. 2, 121-133(Feb 1975).

Town, Smith, and Kaplan (1972, Radiat. Res., 52, 99.) reported that the yield of DNA single-strand breaks (SSB) in E.coli was largely independent of the presence of molecular oxygen during irradiation. They suggested that the oxygen enhancement ratio (o.e.r) normally observed was due to the presence of an ultrafast repair mechanism acting (in bacterial cells) mainly on anoxically produced breaks. To determine whether similar mechanisms exist in mammalian cells, we carried out comparable experiments on two cell-lines, one from Chinese hamster, the other from mouse. Both heat inactivation and chemical inhibition were used to eliminate the supposed enzymic ultrafast repair. Although heat treatment inactivated all the enzymatic processes assayed, it did not alter the o.e.r. for SSB production, which remained about 3.0. The presence of sodium cyanide, hydroxyurea, iodoacetic acid, EDTA, and quinacrine all failed to alter significantly the o.e.r. Isolated nuclei also demonstrated the full o.e.r. For these cell-lines at least, ultrafast repair did not seem to exist. Isolated Adenovirus 2, which presumably lacks enzymic activity, demonstrated an o.e.r. of 3.6 for SSB production. From these results and others it seemed unlikely that the so-called ultrafast enzymic repair was a general phenomenon accounting for the o.e.r. in a wide range of biological systems. Rather, the o.e.r. for SSB seemed to result from differences in the direct physico-chemical effects of radiation under aerobic and anoxic conditions in most organisms. (auth)

9086 TEMPERATURE- AND DOSE RATE-DEPENDENT MODEL FOR THE KINETICS OF CELLULAR RESPONSE TO IONIZING RADIATION. Brannen, J. P. (Sandia Labs., Albuquerque, NM). Radiat. Res.; 62: No. 3, 379-387(Jun 1975).

A kinetic derivation of radiation sensitivity, $1/D_{37}$, which includes both temperature and dose rate as environmental parameters, is given. Some cases are analyzed and applied to data in which temperature and dose rate are variable. (auth)

9087 RELATIONS BETWEEN CELL SURVIVAL MODELS HAVING DIFFERENT INACTIVATION MECHANISMS. Payne, M. G.; Garrett, W. R. (Oak Ridge National Lab., TN). Radiat. Res.; 62: No. 3, 388-394(Jun 1975).

Two different types of cell survival models are considered. In each model it is assumed that both irreversible and reversible lesions (or prelesions) can be formed by the radiation products from one energy-loss event. In the first model further energy-loss events can produce radiation products that can convert the reversible lesions to irreversible ones. The presence of even one irreversible lesion in the cell leads to reproductive death. In the second model reversible lesions can react by way of second-order kinetics to become irreversible and, as in the first model, the presence of one or more irreversible lesions leads to reproductive death. If the parameters in either model are chosen to have magnitudes that are required in the fitting of cell-survival data, approximate analytical survival probabilities can be found, and these are equivalent to the corresponding prediction of the Roesch model. At all stages approximations are made that are appropriate to low LET radiation. (auth)

9088 TIME-RESOLVED OXYGEN EFFECTS IN IRRADIATED BACTERIA AND MAMMALIAN CELLS: A RAPID-MIX STUDY. Shenoy, M. A.; Asquith, J. C.; Adams, G. E.; Michael, B. D.; Watts, M. E. (Mount Vernon Hospital, Northwood, Eng.). Radiat. Res.; 62: No. 3, 498-512(Jun 1975).

An apparatus combining continuous fast-flow mixing with rapid irradiation was used to study the time scale of the oxygen effect in irradiated bacteria and mammalian cells. The range of times used was from 2 to 40 msec between adding O_2 and irradiating, either before or after mixing. The effect of adding O_2 to bacteria either before or after irradiating is dependent on whether the bacteria are suspended in broth or in buffered solution. When O_2 is added before irradiation, larger enhancement ratios are obtained with the bacteria suspended in broth rather than in buffer. When the O_2 is added 5 msec after irradiation, there is a small degree of sensitization in buffer but none in broth. In Chinese hamster cells, the oxygen effect is resolved into two time-dependent components. For O_2 added to these cells 3 to 5 msec before irradiation, the oxygen enhancement ratio (OER) is 1.7 and is independent of the O_2 concentration between 1 and 50 percent. As the time interval from addition of O_2 to irradiation is increased from 5 to 40 msec, the OER increases in a manner dependent upon O_2 concentration. On addition of 50 percent O_2 5 msec after irradiation, only a very small increase in sensitivity is observed. The time-resolved oxygen effects are discussed in terms of possible mechanisms. (auth)

9089 CROSS-SENSITIVITIES OF X-RAY AND UV-LIGHT OF TWO STRAINS OF MURINE LYMPHOMA L5178Y CELLS IN VITRO. Beer, J. Z.; Szumiel, I.; Walicka, M. (Institute of Nuclear Research, Warsaw (Poland)). Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 21: 837-840(1973).

The 254 nm uv-light and 200 kV x-ray dose-survival relationships were determined for two strains of murine leukemic lymphoblasts L5178Y. Mean lethal doses were 54 erg · mm^{-2} and 100 rads for L5178Y-R cells and 85 erg · mm^{-2} and 54 rads for L5178Y-S cells. Split-dose experiments showed that dose fractionation produces sparing effects for uv-exposed L5178Y-S cells and for x-irradiated L5178Y-R cells. Dose fractionation caused marked reduction of relative survivals in the case of uv-exposed L5178Y-R cells and x-irradiated L5178Y-S cells. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 8531, 9057, 9059–9060, 9066–9067, 9086, 9088, and 9217.

9090 (BNWL-1950(Pt. 1), pp 156-157) INDUCTION OF EXOCELLULAR PROTEASES FROM N. CRASSA UNDER CONDITIONS OF NITROGEN STARVATION. Cohen, B.; Drucker, H. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Protease induction from N. crassa starved for nitrogen was found to be similar in requirements to protease induction for carbon-starved cells. The primary difference between the two processes is that the nitrogen-starved cells do not require added protease for induction; however, concentration effects for protein substrate, nature of amino acid repression of the process, and kinetics of protease synthesis were almost identical in the two systems. (auth)

9091 (BNWL-1950(Pt. 1), pp 158-159) INDUCTION OF EXOCELLULAR PROTEASES FROM N. CRASSA BY "CRUDE CELL" PREPARATIONS. Cohen, B.; Drucker, H. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

A fraction was isolated from cells of N. crassa by mild treatment which could effect induction under conditions of carbon or nitrogen starvation. Both the protein present in this fraction and a protease present at low levels in this material appear to play a role in the induction process. (auth)

9092 (BNWL-1950(Pt. 1), pp 162-163) ORIGIN OF ENVELOPE PROTEINS OF A LEUKEMIA VIRUS. Schneider, R. P. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The roles of avian myeloblastosis virus (AMV) and host myeloblast cells in controlling the protein composition of virus envelope and host cell membrane are being studied by examining an ATPase enzyme in the virus and cells. New culture techniques for virus-producing myeloblasts have been developed. (auth)

9093 (IAEA-R-939-F) EFFECT OF IRRADIATION IN EXTENDING SHELF-LIFE OF BOILED CHUB MACKEREL (Rastrelliger spp.). Final Report for the Period 1 October 1970–30 December 1973. Loaharanu, P. (International Atomic Energy Agency, Vienna (Austria)). Aug 1974. 8p. INIS.

8 tables, 7 figs.

With the objectives of achieving shelf-life extension of boiled chub mackerel (Rastrelliger sp.) and the freedom of the product from Cl. botulinum type E hazard, investigations were undertaken to study the effect of low-dose irradiation on the parameters concerned. The fish were boiled in the laboratory according to the traditional method practiced commercially. The boiled fish were packaged in cellophane–Saran–laminated bags and hermetically sealed at atmospheric pressure. This was followed by irradiation at 0, 0.1, 0.2, and 0.3 Mrad resp. All samples were held at ambient temperature (22 to 30°C) until further analysis. Qualitative and quantitative bacteriological determinations in the fish were performed. Moreover, trimethylamine nitrogen, total volatile basic nitrogen, and organoleptic analyses were carried out in the samples. Furthermore, studies on shipping and consumer acceptance of the fish to inland markets in the north and northeast of Thailand (average distance of 700 km) were undertaken. Besides, investigations relating to earliest Cl. botulinum type E toxin formation in irradiated boiled chub mackerel stored at ambient temperature and the determination of storage life of irradiated and non-irradiated spores-inoculated product were embarked upon. On the basis of these experiments, it appeared that irradiation of boiled chub mackerel at doses from 0.1 to 0.3 Mrad significantly increased the storage life of the product at room temperature. A dose of 0.2 Mrad was found sufficient to facilitate the transportation of the product to inland markets in the north and northeast of Thailand. Consumer tests in inland areas indicated that irradiated boiled fish were acceptable up to 4 days of storage life compared to only 2 days for the non-irradiated control. No possible hazard concerning toxin of Cl. botulinum type E could be demonstrated in the irradiated boiled fish, using artificially contaminated fresh fish with spores of Cl. botulinum type E before boiling. On the contrary, it appeared that irradiation of the boiled fish would provide an additional safety factor against botulism hazard. (INIS)

9094 EFFECTS OF NUCLEAR MUTATIONS FOR RECOMBINATION AND REPAIR FUNCTIONS AND OF CAFFEINE ON MITOCHONDRIAL RECOMBINATION. Fraenkel, A. H. M. Columbus, OH; Ohio State Univ. (1974). 166p. University Microfilms Order No. 75-11,342.

Thesis (Ph. D.).

Studies of both prokaryotic and eukaryotic organisms indicate that pathways governing repair of damage to nuclear DNA caused by x-ray or ultraviolet irradiation overlap with those controlling recombination. In this study, fourteen nuclear mutants of Saccharomyces cerevisiae were tested in order to determine whether these mutant genes affected mitochondrial recombination. The mutants studied include one which was recombination deficient, four which were x-ray sensitive, seven which were sensitive in varying degrees to ultraviolet irradiation, and two which were abnormally prone to the mitochondrial petite mutation when irradiated with ultraviolet light. Diploids were constructed which were homozygous for each of the mutant nuclear genes. Output ratios of mitochondrial genes were determined for each of the homozygous mutant diploids and compared to heterozygous and wild-type diploids. None of the mutations studied significantly affected mitochondrial recombination. Minor fluctuations in output ratios were shown to be caused by the effect of background nuclear genome on the input of mitochondrial DNA molecules contributed by each haploid parent to the mating pool of molecules which exists in the zygote. It was concluded that the nuclear recombination and repair pathways studied do not overlap with the nuclear pathway which controls recombination of mitochondrial DNA. None of the fourteen loci tested had an effect on mitochondrial recombination, and therefore the genes controlling mitochondrial recombination must be located elsewhere on the nuclear genome. A second set of experiments was designed to test the effect of caffeine on both nuclear and mitochondrial recombination in Saccharomyces cerevisiae. Caffeine is shown to inhibit significantly both spontaneous and uv-induced nuclear mitotic recombination between the ade2 gene and its centromere. Caffeine did not affect the spontaneous recombination of mitochondrial DNA in either heteropolar or homopolar crosses, but did affect the transmission of parental genes in some treated cells. In several homopolar crosses, caffeine treatment resulted in a bias in favor of the transmission of mitochondrial genes of one parent. Caffeine also was shown to inhibit mitochondrial recombination in a uv-sensitive rad strain which had been irradiated with uv before mating and treated with caffeine before, during, and after mating. (Diss. Abstr. Int. B)

9095 EFFECTS OF RIFAMPICIN ON ELECTRON- AND NEUTRON-IRRADIATED E. COLI B/r AND $B/_{s-1}$. Cramp, W. A.; Bryant, P. E. (Hammersmith Hospital, London). Int. J. Radiat. Biol.; 27: No. 2, 143-156(Feb 1975).

The effect of rifampicin after irradiation with electrons or neutrons on cell-killing, DNA degradation, and the ability of DNA-membrane complex extracted from irradiated bacteria to synthesize DNA was studied in strains E.coli B/r and B_{s-1}. Post-irradiation treatment with rifampicin greatly enhanced the lethal effects of both electrons and neutrons on the repair-proficient strain E.coli B/r under anoxic conditions. However, the same post-irradiation treatment of the repair-deficient strain E.coli B_{s-1} with rifampicin gave no consequent increase in lethality. Rifampicin did not alter the extent of DNA degradation in either strain after irradiation with electrons or neutrons. The DNA-synthetic activity of DNA-membrane complex from electron-irradiated E.coli B/r and B_{s-1} was not altered by post-irradiation treatment with rifampicin, nor did this treatment affect synthesis by DNA-membrane complex isolated from neutron-irradiated B_{s-1}; but the complex, isolated from E.coli B/r which had been irradiated under anoxic conditions with neutrons, showed a marked decrease in activity. We suggest that post-irradiation sensitization with rifampicin of the repair-proficient E.coli B/r, especially after irradiation under anoxic conditions, indicates that initiation of the synthesis of an RNA molecule is involved. In addition, our results suggest that the structure of the membrane complex in E.coli B/r and B_{s-1} is different. (auth)

9096 RADIOSTERILIZED TETRACYCLINE OPHTHALMIC OINTMENT. Nash, R. A. (Lederle Labs., Pearl River, NY). Bull. Parenter. Drug Assoc.; 28: No. 4, 181-187(1974).

The likelihood of FDA approval for a radiosterilized ophthalmic ointment has been resolved. This paper reviews the events that led to Lederle's NDA submission in 1973. The cost savings feature of ^{60}Co gamma ray sterilization in the final package makes it an attractive alternate to conventional aseptic manufacturing and packaging. (auth)

9097 UV-MUTABILITY AND GENETIC RECOMBINATION OF UV-INDUCED GAMMA-RAY SENSITIVE MUTANTS OF NEUROSPORA CRASSA. Mehta, R. D. Edmonton, Ont.; Alberta Univ. (1972). 135p. Thesis.

Six gamma-sensitive mutants were isolated in Neurospora crassa by means of uv-induction of conidia of a wild type strain pe (Y 8743m). All of these mutants showed different degrees of gamma sensitivity. Genetic analysis of these mutants indicated that gamma sensitivity of each of the mutant strain is controlled by a single nuclear gene. Tests for uv-sensitivity revealed that the gamma-sensitive mutants gs-6 is in addition sensitive to uv radiation, whereas the five other mutants and their wild type progenitor are uv-resistant. Tests for uv-mutability showed that fewer mutations for caffeine resistance are induced in all the six gamma-ray sensitive mutants when compared to the wild type strain at equal levels of uv dose or survival. Mutant gs-4 and gs-6 yielded a reduction in the frequency of uv-induced back mutations for adenine prototrophy. In homozygous condition none of the four mutations, gs-2, gs-4, gs-6, and gs-20 affected interallelic recombination as measured by the frequency of prototrophs (pan^+) resulting from pan-2(B3) x pan-2(B5) crosses. The results discussed in the light of comparable data reported for prokaryotes and other eukaryotes facilitate the conclusion that in N. crassa the process of uv-mutagenesis is related to the dark repair systems and that the process of genetic recombination is not directly related to that of uv-mutability. (auth)

9098 SPORULATION OF CLOSTRIDIUM PUTREFACIENS AND THE RESISTANCE OF THE SPORES TO HEAT, γ RADIATION, AND CURING SALTS. Roberts, T. A.; Derrick, C. M. (Agricultural Research Council, Bristol, Eng.). J. Appl. Bacteriol.; 38: No. 1, 33-37(Feb 1975).

A convenient method of producing spores of Clostridium putrefaciens; by growing this anaerobe on lactose-egg yolk agar, is described. The results of a study of the resistance of the spores to heat and to γ radiation in a 4000 Ci ^{60}Co source at ≈0.5 Mrad/hr at 28 to 30°C are reported. Numbers of spores surviving irradiation were determined by plate counts in RCA with sodium bicarbonate. Decimal reduction values were calculated and are summarized in tabular form. The resistance of the spores to γ radiation, D_γ = 0.16 Mrad, was intermediate between the most sensitive and most resistant reported by Roberts and Ingram (J. Fd. Sci.; 30: 879(1965)) and no shoulder was present on the survivor curve. The interrelationship of pH, curing salts, and incubation temperature in inhibiting growth of vegetative cells has also been studied briefly. (UK)

9099 IMMUNOGENIC PROPERTIES OF INFLUENZA A2/HONG KONG/1/68 VIRUS INACTIVATED WITH GAMMA RAYS. Kulevich, E. E.; Kosyakov, P. N. (Inst. of Virusology, Moscow). Vop. Virusol.; No. 6, 696-700(1974). (In Russian).

Influenza A2/Hong Kong/1/68 virus, inactivated with gamma rays, inoculated intranasally induced the formation of antihemagglutinins, CF, and viral-neutralizing antibodies as early as six days after immunization of test animals. The antibody titers were higher in sera than in extracts of the lung and tracheal tissues. A rise in specific antibody titers in the course of immunization correlated with increasing resistance of the immunized animals. Gamma-ray inactivated-influenza virus were adsorbed on RBCs and readily eluted from the RBCs. The antibody titer reaches its maximum 9 to 15 days after immunization. Vaccines inactivated in various ways may be used by intranasal administration if there is a high concentration in them of hemagglutinin. (JPRS)

9100 MICROBIOLOGICAL AND TECHNOLOGICAL LEVEL EFFECTS OF GAMMA IRRADIATION ON RIPE "SAN MARZANO" TOMATOES STORED IN DIFFERENT CONDITIONS. Inghilesi, E.; Magaudda, G. (CNEN, Rome). Sci. Tecnol. Alimenti; 3: No. 2, 91-94(1973). (In Italian).

Weight loss, rottenness, and its microbic origin in ripe "San Marzano" tomatoes irradiated or not with gamma rays (200 and 400 krads) were studied in the present paper. Storage conditions were 20°C, 65% of R.H. and 10°C, 80% of R.H. The results of two different packages, boxes with one layer and small polyethylene bags, were tested. The results obtained show that, in our experimental conditions, irradiation does not prevent rottenness and weight loss is slightly modified. Microbic populations are selected by irradiation according to their radioresistance (Alternaria and Cladosporium). (auth)

9101 PRESERVATION OF TOMATO PUREE BY IONIZING RADIATION. Patkai, G.; Gyoenoes, K. Konzerv- Paprikaip.; No. 2, 49-53(1974). (In Russian).

Tests have been conducted on the preservation of tomato puree containing 28 to 30% soluble solids by ionizing radiation. The aim of these tests was to establish the exposures required for obtaining sterile products and to observe the alterations taking place due to irradiation. The behavior of pigments, flavor substances, and organoleptic properties during storage subsequent to radiation treatment was examined. The results of the microbiological series of experiments showed that complete sterility can be attained by applying an exposure of 2000 krad, no fermentation being observed in any of the samples. On examining the alterations in pigments, the quantitative and qualitative changes in the contents of lycopene and β-carotene were traced by establishing the color value of fat-soluble pigments, by thin-layer chromatography and by gas chromatography. It was found that an exposure of 2000 krad caused no essential alterations in color, flavor, and odor. (Hung. Tech. Abstr.)

9102 MICROBIOLOGICAL AND CHEMICAL TESTS ON GAMMA-IRRADIATED GRAPE. Magaudda, G.; Inghilesi, E.; Belli Donini, M. L. (CNEN, Rome). Sci. Tecnol. Alimenti; 3: No. 4, 3-7(1973). (In Italian).

Grapes for family consumption of the Ohanez variety were exposed to 200 krads gamma rays. The effect on microbial population, observed by using the 50% survival criterion, was similar to that induced by some anticryptogamics. Such an effect lasted a long period of time, according to the various storage conditions. Furthermore, titrimetric tests and analyses of O_2 consumption indicated that, after irradiation, there is a decrease in free acid content and an increase in respiratory metabolism. Finally, three post-irradiation storage conditions were tested (20°C–70% of R.H., 10°C–80% of R.H., 5°C–90% of R.H.), indicating that the darkening of the grape color is accelerated by irradiation. (auth)

9103 STUDIES ON MUTAGENIC EFFECT OF N-NITROSO-DIMETHYLUREA AND ULTRAVIOLET LIGHT ON OXYTETRACYCLINE-PRODUCING ORGANISM ACTINOMYCES RIMOSUS. Vladimirov, A. V. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Antibiotikov, Moscow (USSR)). Antibiotiki; 19: No. 6, 495-501 (Jun 1974). (In Russian).

Ultraviolet light along with the chemical mutagenic agent NDMU were effective in the stepwise selection of strains of higher productivity of antibiotics. The positive results attained overall are connected with the selection of variants that differ insignificantly in level of productivity. (tr-INIS)

Radiation Effects on Plants

Refer also to abstract 8906.

9104 (EUR-5226e) APPLICATION OF ATOMIC ENERGY IN AGRICULTURE. Annual Report, 1973. (Association Euratom-ITAL, Wageningen (Netherlands)). 1974. 164p. Dep. NTIS (US Sales Only) $11.25. EUR B. Fr. 210.-.

Progress is reported in the following areas of research: primary radiation effects; mutation breeding; radiopreservation of food; radiation genetics of insect pests; plant genetics; uptake of specific elements by plants; behavior of elements in soil and water; heavy metals in plants and soils; dosimetric methods; studies on biological material and soils; and practical applications. (HLW)

9105 INDUCTION BY MUTATION OF ALL-YEAR-ROUND FLOWERING IN STREPTOCARPUS. Davies, D. R.; Hedley, G. L. (John Innes Inst., Norwich, Eng.). Euphytica; 24: No. 1, 269-275 (Feb 1975).

A mutant form of Streptocarpus cv. constant nymph has been induced by x irradiation, which shows a drastic change in its flowering habit. Whereas the original form flowers under long-day conditions the mutant flowers under both long- and short-day conditions. The relative performance of these two genotypes in defined growth-room conditions and under natural short-days in the glasshouse is described, as well as the response of the plants to certain growth hormones. (NL)

9106 FURTHER ASPECT OF THE RADIOPROTECTIVE MECHANISM OF THIOUREA. Reddy, S. B. (Louvain Univ. (Belgium). Lab. de Cytogenetique). Strahlentherapie; 149: No. 2, 194-196(1975).

Thiourea in three different concentrations ranging from 10^{-4}M to 10^{-2}M was employed in pre- and post-treatments to test whether it decreases the chromosomal fragment frequency induced by 1,000 R of x rays in the growing root tips of Hordeum vulgare. In pre-treatment experiments thiourea in 10^{-2}M concentrations yielded the maximal protection of 28.9% against radioinduced chromosomal fragments. In post-treatment approximately a similar rate of protection is secured. It is discussed that the test-chemical protected the chromosomes against x rays by two different mechanisms. The recovery process by restitution of the broken chromosomal fragments and the protection against initial radiation damage were the possible protective mechanisms displayed by thiourea in this plant material. (auth)

9107 STUDIES ON THE USE OF MUTAGENIC AGENTS IN LUPINUS. II. Some Mutants of Lupinus Mutabilis After the

Application of Gamma-Irradiation. Pakendorf, K. W. (Stellenbosch Univ. (South Africa). Coll. of Agriculture). Z. Pflanzenzuecht.; 72: No. 2, 152-159(Sep 1974).

A line of Lupinus mutabilis was irradiated with gamma rays at doses varying between 0 and 60 kr. No plants survived the threshold value of 40 kr. A lot of mutants were recovered relating to flower colour, seedcoat colour, seed size, earliness, germination, seed setting ability, and alkaloid content. The future potential of Lupinus mutabilis is discussed in terms of its high protein content, and the fact that it surpassed three other lupin species in 12 out of 18 cases in the amino acid content. (GE)

9108 SIMPLE SCREENING TECHNIQUE FOR BLAST RESISTANT MUTANTS FROM THE RADIATION IRRADIATED RICE POPULATIONS. Kwon, S. H.; Oh, J. H.; Sung, H. S. J. Korean Soc. Crop Sci.; No. 15, 141-143(1974). (In Korean).

An attempt was made to develop a simple testing method for blast resistance in the aged rice plant grown under the paddy field conditions. The blast resistance was tested with the detached 3rd leaves from the top of the plant, which were inoculated by dropping blast spore suspension mixed with 1% Tween 20 on the punched area and kept in 1% sucrose solution. The blast reaction was measured ten days after incubation at 26 to 28°C under highly humid conditions. With this method blast resistant lines were effectively identified and the cost of testing was cheap as compared with any other methods ever practiced. (Korean Sci. Abstr.)

9109 ADAPTATION STUDIES OF RADIATION-INDUCED BARLEY MUTANTS. Ghafoor Arain, A. (Atomic Energy Agricultural Research Centre, Tandojam, Pakistan). Experientia; 31: No. 5, 526-528(15 May 1975).

The environmental stability of 29 radioinduced mutants and 11 cultivars was studied by the method of Eberhart and Russell. The mutants were grouped into stable and adaptable classes. (tr-auth)

9110 DOSE DEPENDENCE OF FORMATION OF ALDEHYDES AS A RESULT OF GAMMA IRRADIATION OF MAIZE SEEDLINGS. Norbaev, N. Uzb. Biol. Zh.; No. 1, 15-17(1975). (In Russian).

It was established that, in maize roots, aldehydes are produced with $E_{\frac{1}{2}} = -1.5$ V. A dependence of the dynamics of aldehyde production on the dose and the time after irradiation was observed. (tr-auth)

9111 BIOLOGICAL SCREENING METHOD FOR MUTATED POLLEN AT THE S-LOCUS BY IN VITRO CULTURE OF POLLINATED PISTIL. Devreux, M.; Laneri, U.; Magnien, E.; Celestre, M. R. (CNEN, Rome). Incompat. Newsl.; No. 5, 17-18(Feb 1975).

Radiation Effects on Animals

Man

Refer also to abstracts 8438, 8909–8911, 9075, 9198, 9200, 9221, and 10637.

9112 (EUR-5068-F) SODIUM–POTASSIUM BURN ACCIDENT. Holst, W. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 15 Jun 1973. 10p. (In French). Dep. NTIS (US Sales Only) $4.00.

The case of a burn caused by spilling NaK at room temperature on the arms of a technician is reported. The arms were immediately placed under running water; the metal fell off the skin in drops and burst into flame, which lasted only a few seconds. The cold running water provided a slight anesthetic effect. First-aid treatment with running water is compared with the oil treatment and the advantages of water treatment are tabulated. (JSR)

9113 (EUR-5287e) RADIOLOGICAL PROTECTION. Technical Recommendations for Monitoring the Exposure of Individuals to External Radiation. (Commission of the European Communities, Luxembourg). 1975. 35p. Dep. NTIS (US Sales Only) $4.75. EUR FB 40,-.

Recommendations are presented for the radiation monitoring of personnel for exposure to external radiation. The calibration and performance of personnel dosemeters are discussed. (CH)

9114 (LBL-3812) AXIAL SCANNING WITH 900-MeV ALPHA PARTICLES. Crowe, K. M.; Budinger, T. F.; Cahoon, J. L.; Elischer, V. P.; Huesman, R. H.; Kanstein, L. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1975. Contract W-7405-eng-48. 4p. (CONF-750335-25). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

High energy (fast) alpha particles can be used for nondestructive radiography of the human body because small electron density changes are reflected in measurable alpha particle energy changes. Using high resolution radiation detectors and computer techniq.. for transaxial reconstruction, it is possible to present informat.. that is not available from conventional radiographs with doses one-tenth that required for photon scanning procedures incorporated in the EMI or similar scanners. (auth)

9115 DIMENSIONS OF THE HUMAN EYE RELEVANT TO RADIATION PROTECTION. Charles, M. W. (Central Electricity Generating Board, Berkeley, Eng.); Brown, N. Phys. Med. Biol.; 20: No. 2, 202-218(Mar 1975).

An attempt has been made to clarify the two most important issues relevant to personal eye dosimetry. This involved the identification of the cells which were most at risk from radiation and the specification of their position in the eye. A survey of the radiobiological literature concerning animals and humans showed that the epithelial cells in the equatorial region of the lens were those which are involved in radiation cataract induction. The depth of these cells has been evaluated in the human eye by means of geometrical construction. The relevant dimensions have been determined from a survey of published anatomical data and supplemented by new data obtained by slit-image photography. In a normal adult population (20 to 65 years) the minimum depth of the incriminated cells was 2.3 ± 0.4 mm; the upper and lower values were associated with young and old subjects respectively. Approximate calculations for isotropic $^{90}Sr/^{90}Y$ and ^{106}Rh β-radiation fields indicated that a planar dosemeter, which integrates the tissue dose between depths of 2.5 to 3.5 mm, should give a reasonable measure of the mean equatorial dose for the variety of eye and irradiation geometries likely to be met during a lifetime exposure. The long established, but tentative, value of 3 mm for the effective depth of the lens was thus confirmed. (auth)

9116 DIGITAL MEASUREMENT SYSTEM FOR RADIATION DOSE DISTRIBUTION. Blackmore, V. J.; Naylor, G. P. (Univ. Hospital of South Manchester, Eng.). Phys. Med. Biol.; 20: No. 2, 314-317(Mar 1975).

Computer treatment planning systems require beam data which can be obtained from digital measurements of the radiation dose distribution in water phantoms. A system has been designed so that the transverse and central axis dose data could be obtained off-line and recorded on punched paper tape, for convenience where the radiotherapy machine and computer are not in close proximity. The system consists of a fixed monitor chamber, a remotely controlled measuring chamber, a digital voltmeter for displaying the dose rate ratio and chamber position, and a standard ASR-33 teletype and punch. The data is automatically printed on the teletype and punched in ASC11 format on the paper tape which may be subsequently input to a computer. (UK)

9117 EFFECT OF X-RAY EXPOSURE ON NITROBLUE-TETRAZOLIUM TEST. Bertotto, A. (Univ., Perugia, Italy); Vaccaro, R.; Forenza, N.; Gandini, G. Lancet; 1: No. 7913, 988(26 Apr 1975).

An abnormally low capacity to reduce nitroblue-tetrazolium (N.B.T.) dye is a useful diagnostic test for various diseases. Prolonged exposure to x rays has also been shown to result in depressed N.B.T. reduction. Blood samples from thirty-six healthy subjects professionally exposed to x rays in hospitals were examined using a latex-stimulated N.B.T. test, and the results compared with control age and sex matched hospital staff. The percentage of neutrophils N.B.T.-reducing leucocytes in the group exposed to x rays showed a significant inverse correlation with the length of exposure. An inverse correlation was also noted between the N.B.T. score and cumulative dose exposure per individual. (UK)

9118 ARNETH–COOKE COUNT: TIMING CANCER THERAPY. Hume, P. D.; Fleming, K. A.; Tavadia, H. B.; Simpson, H. W. (Glasgow Royal Infirmary). Lancet; 1: No. 7910, 802 (5 Apr 1975).

Measurement of the circadian rhythm in proliferative capacity of the bone marrow in the individual patient may be an important clinical prerequisite for "chronotherapy", to increase the therapeutic ratio of tumor/marrow toxicity. The rhythmicity in numbers of circulating white cells (i.e. the short-lived ones of bone-marrow origin–the neutrophils) may have to provide the basis, since multiple bone-marrow aspirations along a 24 hour time scale are not clinically feasible. Circadian variations in neutrophils in man have therefore been studied. The results showed clear-cut circadian rhythms with peak values of nearly double the troughs at 2000 hrs. The "non-segmented" subpopulation of neutrophils showed an earlier (1600 hrs.) and even greater circadian percentage change. The possible association of the circadian adrenocortical rhythm is also discussed. (UK)

9119 LEARNING THE LESSON: ACCIDENTAL RADIATION EXPOSURE OF A MEDICAL RADIOGRAPHER. Jardine, G. C.; Harrison, N. T. (National Radiological Protection Board, Glasgow). Radiol. Prot. Bull.; No. 11, 17-18(Apr 1975).

An accidental radiation exposure of 22-5 rads to a young female radiographer occurred in a general radiography room in a busy X-ray department in a small peripheral hospital. The room was equipped with an overcouch tube and a chest tube both operated from the same generator and control panel. Investigation revealed that during the relevant period two radiographers were assigned to the room, one operating the chest tube and the other the overcouch tube. The chest tube had been selected and energised in error several times, two or three of which coincided with patient preparation on the chest tube. A reconstruction of the incident was made using a water-filled phantom to simulate the radiographer. The results indicated that the exposure of the radiographer could be accounted for by one or more exposures to the useful X-ray beam with part, but certainly not the major part, due to transmitted radiation through the radiographer's upper trunk. Recommendations are made for procedures to be followed to eliminate the possibility of further accidents of this type. (U. K.)

9120 THE NATURAL RADIATION EXPOSURE AND ITS RANGE OF VARIATION IN THE GERMAN FEDERAL REPUBLIC. Bonka, H. (Technische Univ. Berlin (F. R. Germany). Fachbereich Verfahrenstechnik). Atom-Inf.; No. 2, 8-11(1975). (In German).

Corresponding to the source of radiation the total natural exposure can be divided into cosmic, terrestrial, and the body's own component. For all these components mean values and variation ranges are given for the population of the German Federal Republic. The total natural exposure rate is in the mean 103 mrem/a with a variation range for different persons between 65 mrem/a and 300 mrem/a. (GE)

9121 CARCINOMA OF THE PANCREAS. Humphrey, L. J.; Hartman, G. V. (Univ. of Kansas, Kansas City). J. Kans. Med. Soc.; 15: No. 9, 281-282(Sep 1974).

Experience with 17 patients with incurable carcinoma of the pancreas treated by radiation therapy and immunotherapy is described. Results observed have prompted a program of aggressive surgery, radiation therapy, immunotherapy, and long-term chemotherapy. Optimism for significant palliation and survival for these patients with curable and incurable pancreatic carcinoma is warranted. (auth)

9122 PROGRESS IN THE LEUKEMIAS. Galton, D. A. G.; Spiers, A. S. D. Prog. Hematol.; 7: 343-405(1971).

Recent work on the epidemiology of leukemia is reviewed in relation to factors of possible etiologic importance. There is still much geographic variation in the accuracy of diagnosis, the reliability of death certification, and the provision of national registries for classifying leukemia according to cytologic type. This variation and the low incidence of all types of leukemia make difficult the recognition of potentially significant distributions or trends that might suggest the operation of environmental leukemogens and their interaction with genetically determined susceptibility. Exposure to ionizing radiation remains the only predisposing factor beyond doubt for acute and chronic granulocytic leukemia, but its exact role remains obscure. There is no evidence that radiation plays a part in the etiology of chronic lymphocytic leukemia. In the population of survivors of the Hiroshima atomic bomb explosion of 1945, the incidence of leukemia (mainly CGL), though declining in the second 10-year period, was still higher than that of Japan as a whole. The suggestion that the exposure of women to radiation could increase the likelihood of leukemia in their still unconceived children was examined by the Atomic Bomb Casualty Commission in a prospective study of 17,700 children, and no increase in the incidence of leukemia was found in the children of parents who had been heavily exposed to radiation before conception. In the 1960's a decline in the United States mortality rates for leukemia among the white population was recorded. This decline was most marked in children below age 5, and it was suggested that the decline could have resulted from a drop in the use of diagnostic radiology in pregnant women following the reports in 1956 of the Medical Research Council and the National Academy of Sciences on the biologic hazards of radiation. A similar decline in mortality was reported from Norway. (464 references) (CH)

9123 RADIATION ENTERITIS. Ochsner, S. F.; Head, L. H. (Ochsner Clinic and Ochsner Foundation Hospital, New Orleans). J. La. State Med. Soc.; 125: No. 5, 149-153(May 1973).

A comprehensive review of radiation enteritis is presented. Experience in clinical radiation therapy has indicated that the small bowel is the segment of the alimentary tract that is most susceptible to radiation damage. (auth)

9124 LOCAL AND GANGLIONIC TREATMENT FOR EPITHELIOMAS OF THE MOBILE SECTION OF THE TONGUE. Moyse, P.; Dulac, G. L.; Durand, J. C. (Foundation Curie, Paris). Rev. Stomatol.; 74: No. 7, 574-591(1973). (In French).

Topographical classification of epitheliomas of the mobile section of the tongue (the posterior surface, the lateral margin, and the anterior surface: ⅓ anterior or apex, ⅓ median, ⅓ posterior) as well as the T. N. M. classification are recalled. A simplified classification was used: tumor of less than 2 cm, from 2 to 4 cm, and of more than 4 cm. (1) Locally, curative treatment relies on an association of curietherapy, telecobaltotherapy, and glossectomy. Curietherapy should be applied either by itself or in half-doses following telecobaltotherapy, or in the form of bombardment of the area around the lesions immediately prior to glossectomy (this last method prevents necrosis and reduces local recurrences). Between 1961 and 1968, 332 epitheliomas of the tongue were treated by curietherapy. The overall results were: 3 years: 57% survival, and 5 years: 47.5% survival. Metastases, second cancers, and intercurrent diseases explain these figures as between 1964 and 1968 local recurrences were found in only 12% of the cases. Glossectomy plays an increasing part in our treatments: either immediately following bombardment by curietherapy for all lesions of the upper surface of the tongue and for relatively circumscribed lesions of the anterior and middle thirds (60% cure after 3 years), or to deal with a recurrent lesion (⅓ of the cases were cured after 3 years). (2) From the ganglionic point of view, the practice of thorough scraping out is favored. Results where there is partial ganglionic invasion show a rate of cure similar to that of cases where there is no histological invasion. (auth)

9125 SYNOVIORTHESIS WITH YTTRIUM-90. Mueller, W.; Fridrich, R.; Pavelka, K. (Univ., Basel). Dtsch. Med. Wochenschr.; 99: 996-1000(May 1974). (In German).

Yttrium-90 was injected into 64 joints of 41 patients with chronic rheumatoid arthritis or long-persisting joint effusions related to degenerative joint disease. After intraarticular injection of ^{90}Y in adequate dosage (3 to 6 mCi) complete disappearance of the inflammatory changes occurred in 34, while partial therapeutic effect was achieved in 22 joints. No change occurred in eight joints. These results and those reported by others indicate that ^{90}Y synoviorthesis now serves as an alternative method to surgical synovectomy, especially in elderly patients. Side effects are slight. But possible late damage can as yet not be assessed so that indications should still be strict. Large joints, especially of the knee, are particularly suitable for ^{90}Y synoviorthesis, while other radioisotopes must be used for smaller joints. (auth)

9126 EPIDERMODYSPLASIA VERRUCIFORMIS. III. Ultraviolet Micro-Irradiation of Cells in Culture. Moreno, G.; Prunieras, M. (Hopital de Biectre, Le Kremlin-Bicetre, France). Arch. Dermatol. Forsch.; 249: 247-254(29 Apr 1974).

From 3rd annual meeting of the European Society for Dermatological Research; Amsterdam, Netherlands (25 Apr 1973).

Ultraviolet (uv) micro-irradiation of the cell nucleus has been used to study the unscheduled DNA synthesis in cultured fibroblasts of two patients with Epidermodysplasia verruciformis (EV). Cells were micro-irradiated over a nuclear area of 5 μm in diameter with uv doses of the order of 10, 100, and 1000 ergs/mm^2 at 275 nm. The unscheduled DNA synthesis in fibroblasts originated from normal and malignant skin was compared with the unscheduled synthesis in three Xeroderma pigmentosum (XP) cell lines defective for unscheduled synthesis. In cells not in S phase labelled with ^3H-thymidine, the uptake was localized over the irradiated area. No difference in unscheduled DNA synthesis could be detected with this technique in fibroblasts derived from clinically normal skin versus malignant EV lesions, nor was there any difference as compared to normal control cells (KB and WI 38). This confirms preliminary data on one first patient indicating that DNA repair following uv irradiation is not impaired in EV. (auth)

9127 RESULTS OF TREATMENT OF RADIATION-INDUCED SKIN LESIONS FOLLOWING THERAPEUTIC IRRADIATION WITH PHLOGOSAM PREPARATIONS. Lawkowicz, W.; Polubiec, A. (Inst. of Hematology, Warsaw). Wiad. Lek.; 27: No. 13, 1191-1195(1 Jul 1974). (In Polish).

A comprehensive treatment with sulphosalicylic acid in synthetic form was used in patients with skin lesions following therapeutic irradiation. It was found after this that the preparation caused a quicker regression of radiation-induced lesions. In most cases a significant improvement was observed beginning 7 days after the onset of treatment. Radiation-induced skin lesions disappeared completely in 83% of cases after 4 weeks of treatment. (auth)

9128 TREATMENT OF HAND RADIONECROSES USING PLASTIC SURGERY WITH OMENTAL GRAFT AND AUTOLOGOUS FREE SKIN TRANSPLANTS. Kiricuta, I.; Popescu, V. (Institut Oncologique, Cluj). Ann. Chir. Plast., Sem. Hop.; 19: No. 3, 243-246(1974). (In French).

After extensive excision of the radionecrotized tissues, the defect is covered with omentum exteriorized through a minimal laparotomy incision, leaving its vascular supply untouched. The omentum is immediately covered with free skin autologous transplants. Immobilization is maintained for approximately 3 weeks, then the omental pedicle is transected. Two cases with per priman cure are reported. The advantage of the procedure is to allow each radiodystrophic digit to be wrapped up and to insure preservation of the radiodystrophic tendons that will ultimately be revascularized by omental vessels. Early mobilization of the fingers is possible. (auth)

9129 POST-ACTINIC CERVICAL MYELOPATHY. The Late Neurological Complications of Radiotherapy. Critsotakis, J.; Rousta, B.; Zander, E. (Hospital Cantonal Universitaire, Lausanne, Switzerland). Praxis (Bern); 63: No. 38, 1137-1142 (24 Sep 1974). (In French).

Three cases are presented who developed cervical myelopathy after radiotherapy at this level. Radiotherapy was administered in one case for a lympho-epithelial tumor of the epipharynx, in the second case for a small-cell carcinoma of the thyroid and in the third for a trabecular carcinoma of the thyroid; in this third case a neuropathological examination was performed. The discussion deals with the problem of to what extent radiotherapy can cause myelopathy. Literature on this subject is reviewed. (auth)

9130 ETIOLOGY OF HUMAN LEUKEMIAS. Mey, U. (Medizinische Akademie, Erfurt, Ger.). Z. Gesam. Inn. Med. Ihre Grenzgeb.; 29: No. 14, 559-563(15 Jul 1974). (In German).

On the basis of more recent results of cytologic, oncologic, and immunological research the notion of leukemia is to be understood more broadly than it was usual according to the traditional clinical and morphological aspects. The number of signs increases according to which all hematological neoplasias causally underlie homogeneous trigger mechanisms (ionizing radiations, chemical intoxications, virus infections). Taking into consideration the present state of fundamental research, the problems of virus etiology and the cellular changing processes in the development of leukemia are especially discussed. (auth)

9131 RESULTS OF REDUCTION OF BLAND STRUMA BY TREATMENT WITH ^{131}I IN ENDEMIC GOITER AREA OF SOUTHERN BAVARIA. Frey, K. W.; Buell, U.; Heinze, H. G.; Zill, H. (Univ., Munich). Muench. Med. Wochenschr.; 116: No. 20, 1037-1042(17 May 1974). (In German).

The results of treatment of mild goiter with radioactive iodine in 349 patients, treated and followed up between 1958 and 1972, are reported. The mechanical difficulties caused by the goiter could be considerably improved in 70 to 80% with a dosage of 10,000 to 15,000 rad. The circumference of the neck was reduced by an average 1.6 to 1.8 cm, the scintigram surface was reduced by 9.1 to 20% and the maximum ^{131}I storage by 17.5 to 31.3%. Clinically manifest hypothyroidism appeared in 1 to 3% subnormal levels of PB ^{127}I and/or ^{131}I storage in about 10%. The average age of the patients was 64 years. Contra-indications are pregnancy, lactation, juvenile goiter, a suspicion of malignant struma, and larger cold nodules. (auth)

9132 RADON SEED IMPLANTS. Goldstein, N. (Univ. of Hawaii, Honolulu). Arch. Dermatol.; 111: No. 6, 757-759(Jun 1975).

Radon seeds, formerly used for vascular and neoplastic tumors, acne, and other dermatological disorders, are rarely, if ever, used today. Because the half-life of radon is 3,83 days, these hollow gold seeds filled with radon gas are usually left in situ permanently. A case is reported of a woman who had seeds implanted 33 years ago for a vascular lesion. The seeds were removed and found to have minute amounts of residual radiation but not sufficient to cause radiation damage. Since seeds are foreign bodies, removal is recommended if they are easily accessible. (auth)

9133 AUTORADIOGRAPHIC INVESTIGATIONS ON THE CHANGES OF DNA METABOLISM OF THE SQUAMOUS CELL CARCINOMA OF THE COLLUM UTERI DURING TELECOBALT IRRADIATION. Kloke, W. D. Freiburg i.B.; Univ. Freiburg i.B. (1973). 55p. (In German). INIS.

Thesis.

Investigations were made to find a possibility of recognizing as early as possible whether or not a tumor responds to therapy. This way it should be possible to draw conclusions concerning the clinical course or, when occasion arises, to change the therapeutic regimen. Thirty female patients were examined between 1967 and 1971. Tumor biopsies were taken at the 5th, 10th, and 24th day of telecobalt radiotherapy and incubated together with ^{3}H-thymidine. After autoradiographic preparation, the ^{3}H-index was determined. The prognostic significance of this assay was tested on the basis of the observation of the course of the index and of the clinical picture. The test was made in such a way that in the case of correspondence of index prognosis and clinical picture the assay was valued with "yes", otherwise with "no". It was recognized that, with a hit quotient of 78.3%, the ^{3}H-thymidine assay is in the main an objective method to assess the responsiveness of the tumor to the radiotherapy. (GE)

9134 TREATING NON-MALIGNANT CORNEAL CONDITIONS BY RADIOTHERAPY. Naunton, W. J. (United Norwich Hospitals, Eng.). Nursing Times; 70: No. 30, 1149(25 Jul 1974).

The treatment of keratitis and its associated vascularisation of the cornea is a common and difficult problem in ophthalmology. The management and treatment of such problems have been much improved in recent years by the introduction of steroid therapy. Nevertheless, radioactive isotopes can play a very useful part in the treatment of selected cases. Radioactive strontium β rays are soft rays entirely absorbed in 4 millimetres of tissue penetration. This means that only a very superficial layer of tissue is affected by the radiation, and the deeper tissues are not damaged. The cornea, therefore, can be safely irradiated without risk to the underlying tissues such as the iris, cilliary body, and the lens. This is of great importance in the eye as deep radiation passing through the lens can easily form a cataract. (ERB)

9135 THREE CASES OF OSTEORADIONECROSIS OF THE MANDIBLE. Friez, P.; Fitsch-Mouras, C.; Kuffer, R.; Lesage, C.; Marie, J. L. Rev. Stomatol.; 74: No. 8, 650-655(Dec 1973). (In French).

The introduction of high frequency radiation into the treatment of maxillo-facial cancers has increased the number of cases of primary osteoradionecrosis developing spontaneously after treatment. Their very slow and very painful development often leads the surgeon to consider an arresting mandibular resection beyond the probable limits of the necrosis; the patient himself willingly accepts this in the hope of obtaining relief. The authors, in the light of several cases, believe it possible to be more reserved concerning surgery which is always painful both from the functional and the aesthetic point of view. Exercising a great deal of patience and instituting interrupted courses of antibiotherapy, of antalgics and gamma-globulins, they reached the stage where all the sequestra were eliminated and the necrosis definitively cured without having had to use surgery; even in the cases where a pathological fracture marked the progress of necrosis, healing was finally obtained with recuperation of a satisfactory mandibular function. (auth)

9136 ABOUT THE MEDICAL EVACUATION OF HEAD INJURIES IN COMBINATION WITH RADIATION DISEASE. Karakynev, N.; Paskalev, D.; Savov, G.; Antonov, N.; Metev, M. Voenno Med. Delo; 29: No. 1. 9-16(1974). (In Bulgarian).

The common principles of the diagnosis and the sorting of the casualities with head injuries in combination with radiation disease and especially the sorting and the limits of the medical aid in the area of mass casualities are discussed. These contingents should probably be distributed into six main groups. (auth)

9137 THE INFLUENCE OF BLOOD OXYGENATION DURING IN VITRO IRRADIATION UPON THE YIELD OF DICENTRIC CHROMOSOMAL ABERRATIONS IN LYMPHOCYTES. Liniecki, J.; Bajerska, A.; Karniewicz, W. (Instytut Medycyny Pracy w Przemysle Wlokienniczym i Chemicznym, Lodz (Poland)). Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 21: 69-76(1973).

A freshy drawn venous blood, blood oxygenated by equilibration with expired air and whole-blood nonstimulated (PHA-) microcultures of lymphocytes (average partial oxygen tension of 30, 150, and 177 mm Hg, respectively) were irradiated with x-ray doses in the range from 50 to 450 rads, and dicentrics aberrations scored in metaphasal figures of lymphocytes cultured for 51 h. Whereas the dose-effect relationship for irradiated PHA(-) cultures and the aerated blood were not significantly different from each other, that for the venous blood was displaced significantly toward lower values of the dependent variable. When the dose-response curves were fitted to equation of the type $y_d = ax^{\beta}$, the values of the exponent β were significantly higher ($\beta = 1.5$) for all three series than for PHA(+) cultures irradiated in previous studies ($\beta = 1.1$ to 1.2). Additionally, the effect of temperature during irradiation of the venous blood upon aberration yield was studied and found much less pronounced than that operating for irradiated PHA(+) cultures. On basis of available data, it is postulated that in vitro irradiation of venous blood, should yield an adequate reference system for in vitro vs. in vivo dose-effect comparisons. (auth)

9138 ON THE PHASE X-RAY SENSITIVITY OF HUMAN LYMPHOCYTES TO THE ACTION OF PROTONS. Todorov, S.; Ivanov, B.; Mileva, M. (Meditsinska Akademiya, Sofia (Bulgaria). Tsentyr po Zarazni i Parazitni Zabolyavaniya). Eksp. Med. Morfol.; 12: No. 3, 142-145(1973). (In Bulgarian).

Data are presented on cytogenetic analysis of lymphocytes from human peripheral blood, irradiated at the stage G_0 and G_2 of the cellular cycle. There was an increase of chromosomal aberrations with an increase of the dose. Furthermore irradiation at stage G_0 caused the formation of aberrations of chromosomal type, but irradiation at stage G_2 – aberrations of chromatid type. The increase of one-hit aberrations was of linear character at both stages. (auth)

9139 A COMPARATIVE QUANTITATIVE ESTIMATION OF THE CHROMOSOME ABERRATION IN LYMPHOCYTES OF HUMAN PERIPHERAL BLOOD INDUCED BY DIFFERENT KINDS OF IONIZING RADIATION. Todorov, S. (Meditsinska Akademiya, Sofia (Bulgaria) Tsentyr po Zarazni i Parazitni Bolesti). Khig. Zdraveopazvane; 17: No. 3, 251-258(1974) (In Bulgarian).

A quantitative analysis was carried out on the different chromosomic disturbances, induced in lymphocytes of human blood after a treatment with x rays of 180 kV, ^{60}Co gamma radiation, 50 MeV protons, and fission neutrons. The data thus obtained were worked statistically by the method of the last squares and four mathematical models were used: $Y = cD^2$, $Y = cD^n$, $Y = a + bD$, and $Y = a + bD + cD^2$. On the ground of the statistical analysis, the mathematical models were described, which most truly estimated the quantity of the radiation induced chromosome aberrations. The best approximation of two break aberrations, the total number of aberrations, and the realized breaks of the quadratic model appeared as a general regularity. The values of RBE were derived from the linear component of the quadratic model for the various chromosomal disturbances, induced by different types of radiation. The following mean values were obtained: 0.64 ± 0.04 for ^{60}Co gamma irradiation, 0.98 ± 0.6 for protons 50, MeV and 2.28 ± 0.11 for fission neutrons. (auth)

9140 VISUAL EFFECTS DURING THE ACTION OF COSMIC RADIATION AND HIGH ENERGY PARTICLES ON THE EYE. Dimirchogiyan, G. G. (AN Armyanskoj SSR, Erevan, Laboratoriya Zritel'noj Retseptii (USSR)). Biofizika; 19: No. 2, 314-318(Mar 1974). (In Russian).

For English translation see the journal Biophysics.

The effect of penetrating radiation on the retina of the eye has come to the fore recently in connection with phenomena observed in the eyes of cosmonauts during flights to the moon. This most interesting phenomenon is a new manifestation of the very high radiosensitivity of the retina. This phenomenon is considered from the point of view of experimental, radiobiological studies of the retina. A discussion is presented on the part that Cherenkov radiation plays, and on the role of direct radioexcitation of the membranes of the photoreceptors on the phenomenon. (tr-INIS)

9141 SERUM SEROMUCOID LEVELS IN PATIENTS WITH NEOPLASMS AND IN CASES OF RADIATION-INDUCED NECROSIS AFTER NON-SPECIFIC STIMULATION WITH ZYMOSAN. Dobrek, Z.; Majewski, S.; Maciejewski, B. (Instytut Onkologii, Gliwice (Poland)). Pol. Tyg. Lek.; 28: 1886-1889(1973). (In Polish).

Serum seromucoid levels were determined in 44 patients before and after stimulation with Zymosan. The patients were divided into three groups: group I (control) comparized 31 blood donors, group II patients with neoplasms, group III patients with necrosis developing after radiotherapy for neoplasms. The serum seromucoid level was determined by the method of Winzler. A significant decrease of the seromucoid level was found in the group of patients with neoplasms (19 cases) in whom a clinical improvement was observed, and in the group of cured necroses (13 cases). On the other hand, in the group of neoplasms without clinical improvement and in the group of necroses without improvement (5 cases) the seromucoid level increased despite stimulation. It seems that determination of seromucoid level in cases of neoplasms and in radiation-induced necrosis may reflect to some extent the dynamics of the disease process and stimulation effect. (auth)

9142 INCREASE OF RADIATION EXPOSURE TO MANKIND AND ITS CONCLUSIONS. Wachsmann, Felix (Neuherberg bei Muenchen). Magy. Radiol.; 25: No. 3, 129-138(1973). (In Hungarian).

Radiation exposure of an ever increasing rate from artificial sources is added to natural background radiation. According to the ICRU the maximum permissible exposure to the population is 170 mrem/year. This amounts to 5 rem/year for those professionally involved in working with rays. According to author, the data of Sternglass and of Gofmann and Tamplin on exposure hazards to the population are exaggerated, though exposure may by no means be increased any more. Exposure is mainly due to medical and within this field to diagnostic and nuclear examination methods. In some countries medical radiation exposure amounts already to 50 to 100 mrem/year. Exposure may be reduced by developing appropriate techniques and by restricting the indications for examinations. The share of the other sources, even that of atomic plants, is slighter. The hazard due to nuclear experiments shows a decreasing tendency. Also, as opposed to other mortal risk, radiation hazard is rather slight. Since, however, the application of radiations keeps on increasing both in the technical and economical fields, the development of technical procedures to reduce radiation hazard to the population is absolutely necessary. (INIS)

9143 RADIATION INJURY TO THE BONES. Mitrov, G.; Angelova, J.; Kharbov, I.; Todorov, J. (Meditsinska Akademiya, Sofia (Bulgaria). Katedra po Meditsinska Radiologiya). Rentgenol. Radiol.; 13: No. 2, 73-79(1974). (In Bulgarian).

Five patients are reported to have acquired osteoradionecrosis 6 months to 15 years after radiation treatment. Three of these patients receiving telecobaltotherapy of uterine cancer (0.42 percent of all patients with this disease) had radiation necrosis of the neck of the femur which developed after exceeding the exposure dose of 5000 rad. Two patients received preoperative roentgen therapy for breast cancer. In one, the radiation injury was necrosis of capitulum humeri and in the other necrosis of the collar bone and several ribs in the irradiated zone. It is emphasized that essential for development of radiation bone necroses is not only the dose, but also other biological and physical factors (age, application technique, etc.). Painless course of the bone lesions until pathologic fracture occurred was more common than the one reported by other authors. The differential diagnostic difficulties with bone metastases are discussed. All patients had also changes in the irradiated soft tissues: four had radiation ulcer and two radiation cancer. Screen protection of bones which may be shielded from the direct radiation beam and the minimal functional loading may further reduce the incidence of radiation bone necrosis. (auth)

9144 NUCLEAR MATTER AND MATRIX OF LIFE. On The Interaction of High-Energy Physics with Biomedical Science. Larsson, B. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). pp 451-455 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The interaction of high energy particle beams with living matter is briefly reviewed from the point of view of experimental biology. Theoretical considerations as well as reported experimental and clinical findings support the view that such radiations do not differ, qualitatively, in their biological effect on the microscopic level as compared to more easily available radiations of lower energy. This means that common, simple parameters describing the temporal and spatial distribution of energy determine the primary chemical and cellular effects of irradiation. High-energy radiations thus become of particular interest in research and applications concerning multicellular systems (including higher plants and animals) where macroscopic distribution of dose enters as a third, most significant, physical parameter. The main interest of the high-energy radiations is now associated with their use in general biology and clinical medicine as tools for precise probing or treatment of structures difficult to access. (auth)

9145 BEHAVIORAL TOXICOLOGY. Rochester International Conference on Environmental Toxicity, Rochester, New York, June 1972. Weiss, B.; Laties, V. G. (eds.). Environmental Science Research Series, Volume 5. New York; Plenum Publishing Corporation (1975). 488p. (CONF-7206109-).

Behavioral changes in offspring prenatally exposed to ionizing radiation are discussed in a chapter (for which a separate abstract was prepared) on behavioral teratology and toxicology. An additional 16 chapters are included on various aspects of behavioral toxicology. (HLW)

For abstracts of individual chapters see: 9146.

9146 BEHAVIORAL TERATOLOGY AND TOXICOLOGY. Spyker, J. M. (Univ. of Virginia, Charlottesville). pp 311-349 of Behavioral Toxicology. Weiss, B. (ed.). New York; Plenum Publishing Corporation (1975).

From 5th international conference on environmental toxicity: behavioral toxicology; Rochester, NY (Jun 1972).

The increased hazards of prenatal exposure to radiation and other toxic agents are emphasized. Behavioral changes in offspring prenatally exposed to ionizing radiation are discussed. (HLW)

Vertebrates

9147 (BNWL-1950(Pt. 1), pp 87-88) EFFECT OF IRRADIATION ON THE DEVELOPMENT OF FETAL RAT LUNG IN ORGAN CULTURE AND IN UTERO. Vogt, J. C.; Sikov, M. R.; Mahlum, D. D. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The development of fetal lungs and their response to radiation was studied in vivo and in organ culture. Culturing at 13 or 15 days of gestation permitted good growth and differentiation. The damage produced by radiation was partially repaired in vivo, but was irreversible in vitro. Morphologic and biochemical studies indicated that connective tissue biosynthesis is favored over general protein synthesis during in vitro development of irradiated lung. (auth)

9148 (BNWL-1950(Pt. 1), pp 147-149) LOCALIZATION OF ^{35}S–WR2721 IN CELLS. Hampton, J. C. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Compound WR2721 protects mice exposed to 1500 R x rays. Using the intestinal mucosa as a model of a rapidly proliferating cell population, the results of this work show that the compound has little effect on proliferating cells, but rather protects post-mitotic cells. (auth)

9149 (CEA-N-1783) A CONTRIBUTION TO THE DEVELOPMENT OF A MODEL OF GONADAL INVOLUTION IN THE MALE RAT FOLLOWING γ AND NEUTRON EXPOSURES. Lemaire, G.; Grillon, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Feb 1975. 37p. (In French). INIS.

Gonadal involution under the effects of ionizing radiation is a convenient test for RBE studies. Following a previous study in the rat setting forth a model of involution due to ^{60}Co γ rays and neutron from the Harmonie reactor, middle and low doses of particular interest in health physics were investigated in order to determine the threshold of the lowest doses which could be investigated by this technique, and other neutron spectra were studied. Besides, on account of some recent theoretical interpretations pointing out to a dose-rate effect, this effect was investigated for γ exposures, and a finer model was developed. (FR)

9150 (COO-1024-54) COMPARISON OF THE CYTOLOGICAL EFFECTS PRODUCED BY IONIZING RADIATIONS OF DIFFERENT LET. Progress Report, March 1974–April 1975. Riley, E. F. Jr. (Iowa Univ., Iowa City (USA)). 1975. Contract AT(11-1)-1024. 21p. Dep. NTIS $4.25.

Progress is reported on the following research projects: RBE of neutrons and x radiation for effects on rat lens epithelium; effects of x radiation on tumor cell transplants in mice; effects of fast neutrons on ascites tumors; the sparing effect of dose fractionation in the wounded rat lens; and DNA synthesis in wounded rat lens at various times after irradiation. (HLW)

9151 (COO-1602-56) EFFECTS OF X-IRRADIATION ON STEROID BIOTRANSFORMATIONS BY TESTICULAR TISSUE. Progress Report, August 1, 1974–July 31, 1975. Ellis, L. C. (Utah State Univ., Logan (USA)). 1975. Contract AT(11-1)-1602. 10p. Dep. NTIS $4.00.

X irradiation of rat testicular tissue either in vivo or in vitro labilized the lysosomal membranes with a release of both acid phosphatase and phospholipase A_2 resulting in an increased lipid peroxidation. The results from these investigations suggest that the lipid endoperoxides and malonaldehyde are responsible for mediating the effects of radiation on steroid biotransformations. Estradiol, testosterone, 5 alpha-dihydrotestosterone, prolactin, acetylcholine, cGMP, H_2O_2, PUFA, ethanol and vitamin A increased lysosomal fragility and initiated enzyme release while ATP, cAMP, vitamin E, theophylline, indomethacin, caffeine, cortisol, epinephrine, NADPH, NDGA, FSH and Zn^{++} decreased both phenomena. An increase in catalase activity was consistently observed after irradiation and by cAMP indicative of an increase in testicular cAMP content following irradiation. Seminiferous tubules were found to be dependent on prostaglandins for their contractions. (auth)

9152 (IAEA-R-887-F) EFFECTS OF WHOLE BODY GAMMA-RADIATION ON THE RESPIRATORY CHAIN OF MITOCHONDRIA AND THE ANAEROBIC GLYCOLYSIS OF NEW BORN CNS. Final Report for the Period 15 June 1970–30 November 1973. Egana, E. (International Atomic Energy Agency, Vienna (Austria)). May 1974. 17p. INIS.

19 tables, 9 figs.

The effect of whole-body γ irradiation on the mitochondrial respiratory process and oxidative phosphorylation in developing rat CNS, i.e., neonatal, seven, and twenty days of age were examined using a total of about 5,100 rats of both sexes of Wister strain. Radiation effects were analyzed with regard to the diverse factors involved in the mitochondrial respiratory chain such as (1) electron carriers: FAD, coenzyme Co_ϵ, cytochrome C (2) electron donors (specific substrate): succinate, glutamate β-ketoglutarate, β-OHB, pyruvate, GABA, and (3) energy sources: ATP, ADP. Oxygen consumption was measured through two techniques, i.e., polarography with Clark's oxygen electrode and manometry using conventional Warburg apparatus. Oxidative phosphorylation was investigated not only on its radioinduced changes but also with regard to the eventual uncoupling with respiratory process. Examined in addition were the in vitro effect of Ca^{2+} on the respiratory process as well as the radioprotective action of ethanol given ad libitum in drinking water at the concentration of 12% (v/v). The in vitro respiratory process of mitochondria of developing rat subjected to neonatal irradiation with 5, 50, and 500 R was found radioresistant with regard to the "prompt effect" but possibly radiosensitive with regard to the "delayed effects" as was shown by a decrease at 7 days after 500 R and 21 days after 5 and 50 R. Electron carriers such as FAD, Co_ϵ and cytochrome C did not show any significant effect, while energy sources such as ATP and ADP enhanced the mitochondria respiratory process in both normal and irradiated rats. Succinates were found to be the optimal electron donor among the substrates examined. Oxidative phosphorylation (P/O) showed a significant decrease at 7 and 21 days after exposure, in which a clear uncoupling was found in irradiated mitochondria. Ca^{2+} exhibited in general an inhibitory effect on the mitochondria respiratory process particularly at high concentrations, such as 666 μM and over both in normal and irradiated CNS. Ethanol was found to provide no significant protective effect on the survival of adult rats subjected to 1,000 R of γ-rays. (INIS)

9153 (SGAE-2398) SOLCOSERYL AS A POWERFUL RADIOPROTECTIVE COMPOUND. Bauer, D. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Oct 1974. 17p. (BL-127/74). Dep. NTIS (US Sales) $4.00.

In adult inbred mice the blood extract Solcoseryl, when applied singly intraperitoneally or perorally, is able to protect over a comparatively large dose range against a lethal dose of γ irradiation whereby up to 100% survivors were obtained (as compared with practically no survival in the untreated, irradiated animals of the control series). The effect of a low dose of Solcoseryl eliciting only approximately 50% survivors among the animals can be improved up to 100% if the animals were subject to heat adaptation for a period of 6 weeks prior to the Solcoseryl treatment and irradiation and heat adaptation continued during the subsequent observation time. (auth)

9154 (UCB-34P82-18) ELECTROPHYSIOLOGICAL AND BIOCHEMICAL STUDIES OF THE EFFECTS OF RADIATION ON BRAIN ACTIVITY AND DEVELOPMENT. Timiras, P. S.; Valcana, T. (California Univ., Berkeley (USA)). 7 Apr 1975. Contract AT(04-3)-34. 293p. Dep. NTIS $17.75.

Progress is reported on studies of the effects of exposure to various doses of x radiation on the brain of rats. A list of publications is included that report the findings in detail. (CH)

9155 (UR-3490-670) BASIC MECHANISMS OF PERMANENT AND DELAYED RADIATION PATHOLOGY. Casarett, G. W. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. 25p. (CONF-750128-1). Dep. NTIS $4.25.

From symposium on delayed consequences of cancer therapy; Orlando, Florida, USA (9 Jan 1975).

The following topics are reviewed: radioinduced cell reproductive sterilization and mitosis-linked cell necrosis; radioinduced chronic or delayed lesions in parenchymal tissues; relation between parenchymal degeneration and radiation dose; and radioinduced microcirculatory impairment in parenchymal tissues. (HLW)

9156 STUDIES ON THE EFFECTS OF WHOLE-BODY GAMMA IRRADIATION ON CHICKENS INFECTED WITH EIMERIA TENELLA. Merritt, S. V. Madison, WI; Univ. of Wisconsin (1974). 111p. University Microfilms Order No. 75-7598.

Thesis (Ph. D.).

Whole-body exposure of one- and three-week-old White Leghorn cockerels to 600 R gamma radiation (Cesium-137) 24 hours before oral inoculation with 500, 2500, 5000, or 50,000 Eimeria tenella oocysts produced a pattern of mortality differing markedly from

9138 ON THE PHASE X-RAY SENSITIVITY OF HUMAN LYMPHOCYTES TO THE ACTION OF PROTONS. Todorov, S.; Ivanov, B.; Mileva, M. (Meditsinska Akademiya, Sofia (Bulgaria). Tsentyr po Zarazni i Parazitni Zabolyavaniya). Eksp. Med. Morfol.; 12: No. 3, 142-145(1973). (In Bulgarian).

Data are presented on cytogenetic analysis of lymphocytes from human peripheral blood, irradiated at the stage G_0 and G_2 of the cellular cycle. There was an increase of chromosomal aberrations with an increase of the dose. Furthermore irradiation at stage G_0 caused the formation of aberrations of chromosomal type, but irradiation at stage G_2 – aberrations of chromatid type. The increase of one-hit aberrations was of linear character at both stages. (auth)

9139 A COMPARATIVE QUANTITATIVE ESTIMATION OF THE CHROMOSOME ABERRATION IN LYMPHOCYTES OF HUMAN PERIPHERAL BLOOD INDUCED BY DIFFERENT KINDS OF IONIZING RADIATION. Todorov, S. (Meditsinska Akademiya, Sofia (Bulgaria) Tsentyr po Zarazni i Parazitni Bolesti). Khig. Zdraveopazvane; 17: No. 3, 251-258(1974) (In Bulgarian).

A quantitative analysis was carried out on the different chromosomic disturbances, induced in lymphocytes of human blood after a treatment with x rays of 180 kV, ^{60}Co gamma radiation, 50 MeV protons, and fission neutrons. The data thus obtained were worked statistically by the method of the last squares and four mathematical models were used: $Y = cD^2$, $Y = cD^n$, $Y = a + bD$, and $Y = a + bD + cD^2$. On the ground of the statistical analysis, the mathematical models were described, which most truly estimated the quantity of the radiation induced chromosome aberrations. The best approximation of two break aberrations, the total number of aberrations, and the realized breaks of the quadratic model appeared as a general regularity. The values of RBE were derived from the linear component of the quadratic model for the various chromosomal disturbances, induced by different types of radiation. The following mean values were obtained: 0.64 ± 0.04 for ^{60}Co gamma irradiation, 0.98 ± 0.6 for protons 50, MeV and 2.28 ± 0.11 for fission neutrons. (auth)

9140 VISUAL EFFECTS DURING THE ACTION OF COSMIC RADIATION AND HIGH ENERGY PARTICLES ON THE EYE. Dimirchoglyan, G. G. (AN Armyanskoj SSR, Erevan, Laboratoriya Zritel'noj Retseptii (USSR)). Biofizika; 19: No. 2, 314-318(Mar 1974). (In Russian).

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The effect of penetrating radiation on the retina of the eye has come to the fore recently in connection with phenomena observed in the eyes of cosmonauts during flights to the moon. This most interesting phenomenon is a new manifestation of the very high radiosensitivity of the retina. This phenomenon is considered from the point of view of experimental, radiobiological studies of the retina. A discussion is presented on the part that Cherenkov radiation plays, and on the role of direct radioexcitation of the membranes of the photoreceptors on the phenomenon. (tr-INIS)

9141 SERUM SEROMUCOID LEVELS IN PATIENTS WITH NEOPLASMS AND IN CASES OF RADIATION-INDUCED NECROSIS AFTER NON-SPECIFIC STIMULATION WITH ZYMOSAN. Dobrek, Z.; Majewski, S.; Maciejewski, B. (Instytut Onkologii, Gliwice (Poland)). Pol. Tyg. Lek.; 28: 1886-1889(1973). (In Polish).

Serum seromucoid levels were determined in 44 patients before and after stimulation with Zymosan. The patients were divided into three groups: group I (control) comparized 31 blood donors, group II patients with neoplasms, group III patients with necrosis developing after radiotherapy for neoplasms. The serum seromucoid level was determined by the method of Winzler. A significant decrease of the seromucoid level was found in the group of patients with neoplasms (19 cases) in whom a clinical improvement was observed, and in the group of cured necroses (13 cases). On the other hand, in the group of neoplasms without clinical improvement and in the group of necroses without improvement (5 cases) the seromucoid level increased despite stimulation. It seems that determination of seromucoid level in cases of neoplasms and in radiation-induced necrosis may reflect to some extent the dynamics of the disease process and stimulation effect. (auth)

9142 INCREASE OF RADIATION EXPOSURE TO MANKIND AND ITS CONCLUSIONS. Wachsmann, Felix (Neuherberg bei Muenchen). Magy. Radiol.; 25: No. 3, 129-138(1973). (In Hungarian).

Radiation exposure of an ever increasing rate from artificial sources is added to natural background radiation. According to the ICRU the maximum permissible exposure to the population is 170 mrem/year. This amounts to 5 rem/year for those professionally involved in working with rays. According to author, the data of Sternglass and of Gofmann and Tamplin on exposure hazards to the population are exaggerated, though exposure may by no means be increased any more. Exposure is mainly due to medical and within this field to diagnostic and nuclear examination methods. In some countries medical radiation exposure amounts already to 50 to 100 mrem/year. Exposure may be reduced by developing appropriate techniques and by restricting the indications for examinations. The share of the other sources, even that of atomic plants, is slighter. The hazard due to nuclear experiments shows a decreasing tendency. Also, as opposed to other mortal risk, radiation hazard is rather slight. Since, however, the application of radiations keeps on increasing both in the technical and economical fields, the development of technical procedures to reduce radiation hazard to the population is absolutely necessary. (INIS)

9143 RADIATION INJURY TO THE BONES. Mitrov, G.; Angelova, J.; Kharbov, I.; Todorov, J. (Meditsinska Akademiya, Sofia (Bulgaria). Katedra po Meditsinska Radiologiya). Rentgenol. Radiol.; 13: No. 2, 73-79(1974). (In Bulgarian).

Five patients are reported to have acquired osteoradionecrosis 6 months to 15 years after radiation treatment. Three of these patients receiving telecobaltotherapy of uterine cancer (0.42 percent of all patients with this disease) had radiation necrosis of the neck of the femur which developed after exceeding the exposure dose of 5000 rad. Two patients received preoperative roentgen therapy for breast cancer. In one, the radiation injury was necrosis of capitulum humeri and in the other necrosis of the collar bone and several ribs in the irradiated zone. It is emphasized that essential for development of radiation bone necroses is not only the dose, but also other biological and physical factors (age, application technique, etc.). Painless course of the bone lesions until pathologic fracture occurred was more common than the one reported by other authors. The differential diagnostic difficulties with bone metastases are discussed. All patients had also changes in the irradiated soft tissues: four had radiation ulcer and two radiation cancer. Screen protection of bones which may be shielded from the direct radiation beam and the minimal functional loading may further reduce the incidence of radiation bone necrosis. (auth)

9144 NUCLEAR MATTER AND MATRIX OF LIFE. On The Interaction of High-Energy Physics with Biomedical Science. Larsson, B. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). pp 451-455 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The interaction of high energy particle beams with living matter is briefly reviewed from the point of view of experimental biology. Theoretical considerations as well as reported experimental and clinical findings support the view that such radiations do not differ, qualitatively, in their biological effect on the microscopic level as compared to more easily available radiations of lower energy. This means that common, simple parameters describing the temporal and spatial distribution of energy determine the primary chemical and cellular effects of irradiation. High-energy radiations thus become of particular interest in research and applications concerning multicellular systems (including higher plants and animals) where macroscopic distribution of dose enters as a third, most significant, physical parameter. The main interest of the high-energy radiations is now associated with their use in general biology and clinical medicine as tools for precise probing or treatment of structures difficult to access. (auth)

9145 BEHAVIORAL TOXICOLOGY. Rochester International Conference on Environmental Toxicity, Rochester, New York, June 1972. Weiss, B.; Laties, V. G. (eds.). Environmental Science Research Series, Volume 5. New York; Plenum Publishing Corporation (1975). 488p. (CONF-7206109-).

Behavioral changes in offspring prenatally exposed to ionizing radiation are discussed in a chapter (for which a separate abstract was prepared) on behavioral teratology and toxicology. An additional 16 chapters are included on various aspects of behavioral toxicology. (HLW)

For abstracts of individual chapters see: 9146.

9146 BEHAVIORAL TERATOLOGY AND TOXICOLOGY. Spyker, J. M. (Univ. of Virginia, Charlottesville). pp 311-349 of Behavioral Toxicology. Weiss, B. (ed.). New York; Plenum Publishing Corporation (1975).

From 5th international conference on environmental toxicity: behavioral toxicology; Rochester, NY (Jun 1972).

The increased hazards of prenatal exposure to radiation and other toxic agents are emphasized. Behavioral changes in offspring prenatally exposed to ionizing radiation are discussed. (HLW)

Vertebrates

9147 (BNWL-1950(Pt. 1), pp 87-88) EFFECT OF IRRADIATION ON THE DEVELOPMENT OF FETAL RAT LUNG IN ORGAN CULTURE AND IN UTERO. Vogt, J. C.; Sikov, M. R.; Mahlum, D. D. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The development of fetal lungs and their response to radiation was studied in vivo and in organ culture. Culturing at 13 or 15 days of gestation permitted good growth and differentiation. The damage produced by radiation was partially repaired in vivo, but was irreversible in vitro. Morphologic and biochemical studies indicated that connective tissue biosynthesis is favored over general protein synthesis during in vitro development of irradiated lung. (auth)

9148 (BNWL-1950(Pt. 1), pp 147-149) LOCALIZATION OF ^{35}S–WR2721 IN CELLS. Hampton, J. C. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Compound WR2721 protects mice exposed to 1500 R x rays. Using the intestinal mucosa as a model of a rapidly proliferating cell population, the results of this work show that the compound has little effect on proliferating cells, but rather protects post-mitotic cells. (auth)

9149 (CEA-N-1783) A CONTRIBUTION TO THE DEVELOPMENT OF A MODEL OF GONADAL INVOLUTION IN THE MALE RAT FOLLOWING γ AND NEUTRON EXPOSURES. Lemaire, G.; Grillon, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Feb 1975. 37p. (In French). INIS.

Gonadal involution under the effects of ionizing radiation is a convenient test for RBE studies. Following a previous study in the rat setting forth a model of involution due to ^{60}Co γ rays and neutron from the Harmonie reactor, middle and low doses of particular interest in health physics were investigated in order to determine the threshold of the lowest doses which could be investigated by this technique, and other neutron spectra were studied. Besides, on account of some recent theoretical interpretations pointing out to a dose-rate effect, this effect was investigated for γ exposures, and a finer model was developed. (FR)

9150 (COO-1024-54) COMPARISON OF THE CYTOLOGICAL EFFECTS PRODUCED BY IONIZING RADIATIONS OF DIFFERENT LET. Progress Report, March 1974–April 1975. Riley, E. F. Jr. (Iowa Univ., Iowa City (USA)). 1975. Contract AT(11-1)-1024. 21p. Dep. NTIS $4.25.

Progress is reported on the following research projects: RBE of neutrons and x radiation for effects on rat lens epithelium; effects of x radiation on tumor cell transplants in mice; effects of fast neutrons on ascites tumors; the sparing effect of dose fractionation in the wounded rat lens; and DNA synthesis in wounded rat lens at various times after irradiation. (HLW)

9151 (COO-1602-56) EFFECTS OF X-IRRADIATION ON STEROID BIOTRANSFORMATIONS BY TESTICULAR TISSUE. Progress Report, August 1, 1974–July 31, 1975. Ellis, L. C. (Utah State Univ., Logan (USA)). 1975. Contract AT(11-1)-1602. 10p. Dep. NTIS $4.00.

X irradiation of rat testicular tissue either in vivo or in vitro labilized the lysosomal membranes with a release of both acid phosphatase and phospholipase A_2 resulting in an increased lipid peroxidation. The results from these investigations suggest that the lipid endoperoxides and malonaldehyde are responsible for mediating the effects of radiation on steroid biotransformations. Estradiol, testosterone, 5 alpha-dihydrotestosterone, prolactin, acetylcholine, cGMP, H_2O_2, PUFA, ethanol and vitamin A increased lysosomal fragility and initiated enzyme release while ATP, cAMP, vitamin E, theophylline, indomethacin, caffeine, cortisol, epinephrine, NADPH, NDGA, FSH and Zn^{++} decreased both phenomena. An increase in catalase activity was consistently observed after irradiation and by cAMP indicative of an increase in testicular cAMP content following irradiation. Seminiferous tubules were found to be dependent on prostaglandins for their contractions. (auth)

9152 (IAEA-R-887-F) EFFECTS OF WHOLE BODY GAMMA-RADIATION ON THE RESPIRATORY CHAIN OF MITOCHONDRIA AND THE ANAEROBIC GLYCOLYSIS OF NEW BORN CNS. Final Report for the Period 15 June 1970–30 November 1973. Egana, E. (International Atomic Energy Agency, Vienna (Austria)). May 1974. 17p. INIS.

19 tables, 9 figs.

The effect of whole-body γ irradiation on the mitochondrial respiratory process and oxidative phosphorylation in developing rat CNS, i.e., neonatal, seven, and twenty days of age were examined using a total of about 5,100 rats of both sexes of Wister strain. Radiation effects were analyzed with regard to the diverse factors involved in the mitochondrial respiratory chain such as (1) electron carriers: FAD, coenzyme Co_8, cytochrome C (2) electron donors (specific substrate): succinate, glutamate β-ketoglutarate, β-OHB, pyruvate, GABA, and (3) energy sources: ATP, ADP. Oxygen consumption was measured through two techniques, i.e., polarography with Clark's oxygen electrode and manometry using conventional Warburg apparatus. Oxidative phosphorylation was investigated not only on its radioinduced changes but also with regard to the eventual uncoupling with respiratory process. Examined in addition were the in vitro effect of Ca^{2+} on the respiratory process as well as the radioprotective action of ethanol given ad libitum in drinking water at the concentration of 12% (v/v). The in vitro respiratory process of mitochondria of developing rat subjected to neonatal irradiation with 5, 50, and 500 R was found radioresistant with regard to the "prompt effect" but possibly radiosensitive with regard to the "delayed effects" as was shown by a decrease at 7 days after 500 R and 21 days after 5 and 50 R. Electron carriers such as FAD, Co_8 and cytochrome C did not show any significant effect, while energy sources such as ATP and ADP enhanced the mitochondria respiratory process in both normal and irradiated rats. Succinates were found to be the optimal electron donor among the substrates examined. Oxidative phosphorylation (P/O) showed a significant decrease at 7 and 21 days after exposure, in which a clear uncoupling was found in irradiated mitochondria. Ca^{2+} exhibited in general an inhibitory effect on the mitochondria respiratory process particularly at high concentrations, such as 666 μM and over both in normal and irradiated CNS. Ethanol was found to provide no significant protective effect on the survival of adult rats subjected to 1,000 R of γ-rays. (INIS)

9153 (SGAE-2398) SOLCOSERYL AS A POWERFUL RADIOPROTECTIVE COMPOUND. Bauer, D. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Oct 1974. 17p. (BL-127/74). Dep. NTIS (US Sales) $4.00.

In adult inbred mice the blood extract Solcoseryl, when applied singly intraperitoneally or perorally, is able to protect over a comparatively large dose range against a lethal dose of γ irradiation whereby up to 100% survivors were obtained (as compared with practically no survival in the untreated, irradiated animals of the control series). The effect of a low dose of Solcoseryl eliciting only approximately 50% survivors among the animals can be improved up to 100% if the animals were subject to heat adaptation for a period of 6 weeks prior to the Solcoseryl treatment and irradiation and heat adaptation continued during the subsequent observation time. (auth)

9154 (UCB-34P82-18) ELECTROPHYSIOLOGICAL AND BIOCHEMICAL STUDIES OF THE EFFECTS OF RADIATION ON BRAIN ACTIVITY AND DEVELOPMENT. Timiras, P. S.; Valcana, T. (California Univ., Berkeley (USA)). 7 Apr 1975. Contract AT(04-3)-34. 293p. Dep. NTIS $17.75.

Progress is reported on studies of the effects of exposure to various doses of x radiation on the brain of rats. A list of publications is included that report the findings in detail. (CH)

9155 (UR-3490-670) BASIC MECHANISMS OF PERMANENT AND DELAYED RADIATION PATHOLOGY. Casarett, G. W. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. 25p. (CONF-750128-1). Dep. NTIS $4.25.

From symposium on delayed consequences of cancer therapy; Orlando, Florida, USA (9 Jan 1975).

The following topics are reviewed: radioinduced cell reproductive sterilization and mitosis-linked cell necrosis; radioinduced chronic or delayed lesions in parenchymal tissues; relation between parenchymal degeneration and radiation dose; and radioinduced microcirculatory impairment in parenchymal tissues. (HLW)

9156 STUDIES ON THE EFFECTS OF WHOLE-BODY GAMMA IRRADIATION ON CHICKENS INFECTED WITH EIMERIA TENELLA. Merritt, S. V. Madison, WI; Univ. of Wisconsin (1974). 111p. University Microfilms Order No. 75-7598.

Thesis (Ph. D.).

Whole-body exposure of one- and three-week-old White Leghorn cockerels to 600 R gamma radiation (Cesium-137) 24 hours before oral inoculation with 500, 2500, 5000, or 50,000 Eimeria tenella oocysts produced a pattern of mortality differing markedly from

nonirradiated, infected (NRI) control birds. While all NRI birds survived inoculation of up to 5000 oocysts, the irradiated, infected birds exhibited a gradually increasing mortality rate beginning at 500 (three-week-old birds) and 2500 (one-week-old birds) oocysts and reaching a level near 90 percent at an oocyst dosage of 50,000. When oocyst dosage was held constant (2500) and radiation exposure increased (250, 450, 600, 800, or 1000 R) a similar, gradual increase in mortality rate with higher radiation dosages was observed among both one- and three-week-old birds. Birds irradiated 24 hours or more before inoculation were less able to survive infection than were those irradiated one hour before and one, two, three, or four days after inoculation. The mortality rate of birds irradiated (600 R) two days before inoculation (2500 oocysts) was significantly higher than for birds irradiated within one hour before and one, two, or four days after inoculation and for NRI controls. The mortality rate for birds irradiated two days before inoculation was significantly higher than for birds irradiated within one hour before and two or four days after inoculation. The effects of exposure to 1000 R and 600 R on the nonlymphoid portions of the cecum were examined histologically at one, three, 24, 48 hours and five and nine days after exposure. The normal histology of the cecal tonsil was described and the effects of exposure to 1000 and 600 R were examined. The observed histological effects of radiation exposure, when reviewed in relation to the survival enhancement occurring among birds irradiated after inoculation, suggest the following: 1) Survival enhancement of birds irradiated after inoculation is not adequately explained by host epithelial cell damage, since recovery of these cells precedes development of the trophozoite stage of the parasite when inoculated two, three, or four days after irradiation; 2) Loading of macrophages with cell debris following exposure to radiation might interfere with normal transport of sporozoites in birds irradiated one hour before or one or two days after inoculation; 3) Selective repopulation of the cecal tonsil by antigen-stimulated lymphocytes and/or plasmocytes remains a valid partial explanation for the survival enhancement observed. The use of irradiated chickens as immunologically incompetent hosts within which to test the relative capabilities of homologous immune cells to confer resistance to infection by E. tenella was examined. Preliminary results with a small number of birds showed homologous immune bone marrow cells + immune serum (IS) to be more effective than immune spleen cells + IS, immune cells + IS or IS alone in reducing the number of cecal oocysts produced. This effect was amplified following a challenge infection. Methods developed herein may provide a model for use in extending our understanding of the role of the various lymphoid elements in the development of immunity to Eimeria infections. (Diss. Abstr. Int. B)

9157 EFFECTS OF X IRRADIATION ON THE DYNAMICS OF THE BRAIN ELECTRICAL ACTIVITY DURING DIFFERENT PHASES OF SLEEP. Kiknadze, N. R. (Inst. of Physiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 77: No. 2, 445-448(Feb 1975). (In Russian).

The dynamics of the electrical activity in different structures of the brain during the wakefulness-sleep cycle was studied by means of x irradiation (400 R) in cats with chronically implanted electrodes. After x irradiation, suppression of the hippocampal theta rhythm is observed in paradoxical sleep, whereas during wakefulness and deep slow-wave sleep it remains unchanged. The neocortical electrical activity develops only temporary changes, returning to background activity within 2 to 3 days. It is suggested that on the one hand, x irradiation exerts a specific effect selectively on the neurophysiological and neurohumoral mechanisms of the paradoxical phase of sleep and on the other, the paleocortical structures are more sensitive to x irradiation in comparison with the neocortex. (auth)

9158 COMPARISON OF RADIATION RESPONSE, CYANIDE TOXICITY, AND SULFUR TRANSFERASE ACTIVITY IN NATIVE NORTH AMERICAN RODENTS. O'Farrell, T. P.; Dilley, J. V. (Battelle Pacific Northwest Labs. Richland, WA). Comp. Biochem. Physiol.; 50: No. 3B, 44-47(15 Mar 1975).

Nine species of rodents representing three Families were exposed to ionizing radiation from a 10,000 Ci ^{60}Co source, or to potassium cyanide, to determine whether sensitivity to KCN might be used as an index to radiation response of the species, and to document the comparative responses of the species to the stresses. There was a twofold variation between the responses of the most sensitive, Oryzomys palustris (525 rad), and the most resistant species, Perognathus longimembris (1094 rad), following radiation treatment. There was no apparent relationship between radiation responses and taxonomic affinity or adaptation to high altitude. There was a taxonomic ordering of responses to cyanide with members of the Family Heteromyidae most sensitive (4 mg/kg), Muridae intermediate in response, and members of the Family Cricetidae most resistant (9.6 mg/kg). There was no correlation between radiation resistance and KCN toxicity in the Families Muridae and Heteromyidae, but there was a strong positive correlation in the Family Cricetidae. The inconsistent results would preclude use of cyanide toxicity as an index to radiation sensitivity in rodents in general, but might apply in some larger Families. Results of cyanide exposures and sulfur transferase activity suggested that resistance to ionizing radiation could not be totally related to the availability of free sulfhydryl groups. (auth)

9159 DIURNAL VARIATIONS IN RADIOSENSITIVITY OF MOUSE INTESTINE. Hendry, J. H. (Christie Hospital and Holt Radium Inst., Manchester). Br. J. Radiol.; 48: No. 568, 312-314(Apr 1975).

Crypts in the mouse small intestine showed a diurnal rhythm in radiosensitivity and were most sensitive in the middle of the dark period, when mitotic activity in the crypt was high. Analysis of crypt survival on a cellular basis showed that the changes in cryptogenic cell radiosensitivity were dose-modifying between 1,000 and 1,450 rads γ rays such that the D_0 value varied between 85 rads and 140 rads. (auth)

9160 MECHANISMS OF RADIO-PROTECTION BY CATECHOLAMINES IN THE HAMSTER (MESOCRICETUS AURATUS). Prewitt, R. L.; Musaccaia, X. J. (Univ. of Missouri, Columbia). Int. J. Radiat. Biol.; 27: No. 2, 181-191(Feb 1975).

Whole-body exposure to 1000 or 2000 rads in a ^{60}Co source was used to study radio-protection by norepinephrine, isoproterenol, and phenylephrine in normal and splenectomized hamsters. After exposure, the animals were caged individually, and percent survivals were recorded daily. The aortic blood pressure of permanently cannulated, unanaesthetized hamsters was measured to test the vasoconstriction-hypoxia mechanism of radio-protection, and plasma calcium levels were measured to test the hypothesis that isoproterenal protects through a mechanism of hypercalcaemia-stimulated cell proliferation. The data supported the vasoconstriction-hypoxia mechanism for agents stimulating the alpha receptors, while beta agonists seemed to protect through a hypotensive-hypoxia mechanism similar to that of histamine. All the catecholamines protected against the hematopoietic syndrome, but showed no evidence of protection against the gastrointestinal syndrome. (auth)

9161 CENTROMERIC ASYMMETRY AND INDUCTION OF TRANSLOCATIONS AND SISTER CHROMATID EXCHANGES IN MOUSE CHROMOSOMES. Lin, M. S.; Davidson, R. L. (Harvard Medical School, Boston). Nature (London).; 254: No. 5498, 354-356(27 Mar 1975).

Some studies are described on radiation and drug induced chromosomal translocation and sister chromatid exchange in mouse chromosomes, using the centrometric asymmetry technique. The relationship between DNA polarity and chromosomal rejoining in x-ray induced translocations was examined cytologically. (UK)

9162 BIOLOGICAL DETECTION OF REDUCTION IN DOSE AT THE SURFACE OF VOLUME SOURCES CONTAINING BETA EMITTERS. Witcofski, R. L. (Bowman Gray School of Medicine, Winston-Salem, NC); Smith, E. M.; Pizzarello, D. J. Phys. Med. Biol.; 20: No. 2, 255-260(Mar 1975).

Dosimetry theory related to volume sources containing uniformly distributed beta-emitting radionuclides predicted a rapid drop in dose at the outer surface to approximately one half of the maximum dose within the volume. The purpose of this study was to determine if this reduction in surface dose could be observed using a measurable biological endpoint. In this study rats were injected with radiocolloids of either ^{198}Au, ^{113m}In or ^{99m}Tc, to produce liver irradiation from their decay, or their livers were treated with external x irradiation. After irradiation, a portion of the liver was surgically removed to stimulate cell division in the liver remnant revealing radiation damage in the form of chromosomal aberrations. The percentages of dividing cells with bridges were scored in the outer edges (0.45 mm) of the tissue sections and were compared to levels obtained from the central portion of the liver lobe. No significant difference was observed with x irradiation or from ^{99m}Tc irradiation. However, irradiation with ^{198}Au and ^{113m}In (which emit large numbers of energetic electrons) produced significantly fewer aberrations in the outer layer when compared to the central portion. These differences in the distribution of biological damage allowed us to detect the predicted dose reduction at the surface of volume sources containing beta emitters. (auth)

9163 STIMULATION OF IgG ANTIBODY FORMATION BY SUBLETHAL IRRADIATION DURING PERSISTENTLY REPEATED IMMUNIZATION WITH BRUCELLA ABORTUS. Gras, J.; Morros, J. M.; Guix, J.; Tuset, N. (Dept. of Investigation, Barcelona). Immunology; 28: No. 4, 629-634(Apr 1975).

Whole-body irradiation with 600 rads 8 or 10 days after the beginning of persistently repeated Brucella abortus immunization in the rabbit produced little change in the response. By contrast, irradiation with the same dose 2, 4, or 6 days after the beginning of repeated immunization stimulated the IgG response. This effect was explained by a repopulation of antigen-sensitive cells from precursor cells to a higher level than that previous to irradiation. In order to explain IgG stimulation, three main possibilities were considered: (a) a T cell-dependent mechanism, consequent on a higher radioresistance of T than of B cells, or on a faster and more extensive repopulation by T cells; (b) another T cell-dependent mechanism due to a greater radiosensitivity of the suppressor or inhibitory T-cell subpopulation, with the result of a predominance in the T cell population that helps IgG formation; (c) a mechanism depending on antigen presence during the repopulation of antigen-sensitive cells from the precursor cells, according to previously obtained data suggesting the necessity for the persistence of a certain level of antigen for IgG formation. (auth)

9164 IN VIVO RADIORESISTANCE OF ACTIVATED T CELLS INVOLVED IN THE GRAFT. Cauchi, M. N.; Dawson, K. B. (Inst. of Cancer Research, Sutton, Eng.). Int. J. Radiat. Biol.; 27: No. 2, 193-195(Feb 1975).

Although the lymphoid system is extremely sensitive to radiation damage, certain classes of lymphocytes have been shown to be relatively radioresistant. Since no results were available for the in vivo radiosensitivity of cells responsible for the production of the graft-versus-host (GVH) reaction, the rate of in vivo acquisition of radioresistance by these cells has been studied. Suspensions of parental rat spleen cells were injected under the capsule of the left kidney of hybrid rats under anaesthesia. Either the cells were x-irradiated in vitro just before injection, or the left kidney region was irradiated in vivo three days after injection. The magnitude of the GVH reaction was assessed on the seventh day after transplantation by measuring both the weight of the kidneys and the uptake of ^{125}I-iododeoxyuridine. The cells irradiated in vitro were very radiosensitive (D_0 = 52 rads), in marked contrast to the resistance shown when irradiated in situ (D_0 = 482 rads). An investigation of the rate of acquisition of this radioresistance was then carried out. Cells were injected under the kidney capsule and irradiated 1 hour to 7 days later. One hour after transplantation the radioresistance of the cells had increased (in vitro, 1.5% survival after 280 rads; in vivo, 30% survival after 280 rads). There was some increase in radioresistance at 24 hours after transplantation, but no subsequent increase. These results showed that the T cells responsible for initiating the GVH reaction rapidly become very radioresistant after activation in vivo. (UK)

9165 NEUROPATHOLOGY. Kaufman, M. A.; Roizin, L.; Gold, G. Progr. Neurol. Psychiat.; 26: 97-121(1971).

The etiology of neuropathies in man and animals is reviewed. X-irradiation of rabbits on the 18th day of fetal life with 150 R disturbed the normal developmental changes of tissue respiration and anaerobic glycolysis of brain during ontogenesis. X-irradiation of the brain of 7-day-old rats (600 R) resulted in a large selective deficit of cerebellar weight at 7 1/2 months with a substantial increase of cellularity. A reduction in the cellular response to superficial freezing injury was dependent on the dosage of previous local brain x-irradiation, but independent of the time interval between irradiation and injury. It was suggested that radiation damage was stored up in local cells until they were stimulated to divide, when they died. Similar modifications were also induced in the response to subsequent intracerebral infection with Bacillus pertussis and were believed to support the view that brain macrophages are of local origin. The similarity of mast cell changes induced by compound 48/80 in both acute and chronic stages to those in irradiated monkey brains suggested that some of the lesions may reflect a process of delayed hypersensitivity with antigen provided by some component of the mast cells. (auth)

9166 EFFECT OF X-IRRADIATION ON SOME ENZYME LEVELS IN RAT SMALL INTESTINE. Sobo, A. O.; Skillen, W. (Royal Victoria Infirmary, Newcastle upon Tyne, Eng.). J. Nat. Med. Ass.; 66: 328-329(Jul 1974).

Following whole-body or localized x irradiation the absorption of glucose by rats was shown to be significantly reduced. The mechanism of glucose transport by the intestinal mucosa has not been clearly established but there is little doubt that it is an energy dependent process. It may be that the defective glucose uptake is a result of a decrease in the energy production of the irradiated tissues. The levels of a number of enzymes in irradiated and sham-irradiated rat small intestine were measured. Any variation in enzyme levels due to x-irradiation may help to characterize the defect which results in the lowered glucose uptake. (auth)

9167 EFFECT OF SINGLE DOSE IRRADIATION ON ISOLATED PERFUSED CANINE KIDNEY. Malek, G. H.; Richards, M. J. S.; Burkholder, P. M.; Caldwell, W. L. (Univ. of Wisconsin, Madison). Surgery; 76: No. 2, 272-277(Aug 1974).

Passenger leukocytes may be a primary stimulus for renal allograft rejection. Massive single dose in vitro irradiation in a cold, hypoxic environment was suggested as a method of eradicating such leukocytes. This study was undertaken to evaluate the tolerance of isolated, cooled, hypoxic canine kidneys to massive in vitro irradiation before autotransplantation, a critical factor if such a method would be useful in delaying rejection. Sixteen dogs were divided into eight groups, with two dogs serving as controls. After perfusion for 4 to 5 minutes, doses of irradiation ranging from 2,000 to 10,000 rads were delivered to each isolated test kidney in a cold, hypoxic environment prior to autotransplantation. Single doses of less than 3,000 rads were tolerated, with acceptable renal function remaining for up to eight months. However, this dose of irradiation is not sufficient to delay significantly allograft rejection. It seems unlikely that renal tissues can be sufficiently protected by a cold, hypoxic environment at the time of irradiation to allow preferential killing of passenger leukocytes to the extent to make this approach clinically feasible. (auth)

9168 SURFACE MORPHOLOGY OF IRRADIATED MACROPHAGES. Geiger, B.; Gallily, R. (Hebrew Univ., Jerusalem). RES, J. Reticuloendothel. Soc.; 15: No. 4, 274-281(Apr 1974).

Both general morphology and fine ultrastructure of membranes were investigated in macrophages derived from x-irradiated and normal mice. Notable differences were found between the two cell types. Irradiated macrophages contained numerous small invaginations or holes on their outer surfaces, while normal cells had few such structures. Scanning electron microscopy revealed that macrophages of mice irradiated in vivo with either 550 R or 800 R were round or elongated, respectively, while cells derived from nonirradiated animals displayed no uniformity in shape. (auth)

9169 METASTASIS AND GROWTH OF FRIEND TUMOR CELLS IN IRRADIATED SYNGENEIC HOSTS. Matioli, G. (Univ. of Southern California, Los Angeles). RES, J. Reticuloendothel. Soc.; 15: No. 4, 282-296(Apr 1974).

Friend tumor cells (FTC) have been studied by growing them in lethally irradiated syngeneic mice. After establishing the FTC dilution factor (δ), extinction factor (Q), and the optimal time for colony counts, the FTC kinetic was analyzed by the recovery curve method. It was found that FTC growth is different from that experienced by normal or leukemic Friend stem cells when tested by the same in vivo assay. The most interesting differences were the high metastatic activity, the lack of differentiation, the deterministic growth, and the independence from the spleen microenvironment experienced by the FTC, in contrast with the normal and leukemic stem cells. In addition, the estimate of the critical size the FTC colony has to reach before releasing the first metastatic cells is presented. (auth)

9170 CYTOGENETIC ANALYSIS OF BONE MARROW PROTECTION WITH MEXAMINE IN DIFFERENT IRRADIATION DOSES. Voitkevich, N. D.; Palyga, G. F.; Yarmonenko, S. P. (Scientific Research Inst. of Medical Radiology, Moscow). Med. Radiol.; No. 11, 12-17(1974). (In Russian).

It was found that in the case of a one-time whole-body irradiation (^{60}Co) of white mongrel male mice, in the range of 150 to 450 rad, under the influence of previously administered mexamine, the number of injured metaphases of the bone marrow cells significantly decreased, and the degree of radiation damage to chromosomes dropped. The counter-radiation effect of mexamine depends on the amount of protective agent administered. Cytogenetic investigation of the bone marrow conducted during the first mitosis after irradiation (in 12 to 24 hour) is recommended as a model for the assessment of the protective influence of the counter-radiation agents. (JPRS)

9171 ULTRASTRUCTURAL CHARACTERIZATION OF A THYMIC X-CELL TYPE IN SUBLETHALLY IRRADIATED MOUSE. Correlations With the Bone Marrow X-Cell Population. Boniver, J.; Delrez, M.; Hoat, J.; Simar, L. J.; Betz, E. H. (Univ., Liege). Beitr. Pathol.; 152: No. 1, 81-94(1974).

The ultrastructural study of the mouse thymus during recovery after a sublethal irradiation reveals the appearance in the subcapsular zone of a peculiar type of lymphoid blast cells, i.e., the X-cells. These peculiar cells are similar to those described in the bone marrow during the postirradiation lymphoid rebound. A normal syngeneic bone marrow graft after irradiation prevents the X-cell accumulation both in the thymus and the bone marrow. Several arguments suggest that X-cells do not participate actually in the thymic regeneration. It is postulated that thymic X-cells, like marrow X-cells, belong to an embryonic cell line reappearing

in the adult mouse after irradiation. Chronological and topographical correlations with the thymic immature lymphoid cells suggest that the X-cell could be the target cell for the leukemogenic virus. (auth)

9172 AGE DEPENDENCE OF GLYCOGEN METABOLISM IN THE BONE TISSUE OF RATS UNDER CONDITIONS OF GENERAL RADIATION EXPOSURE. Frenkel, L. A. Eksp. Klin. Radiol.; 9: 150-153(1973). (In Russian).

In experiments on white rats — males of the Wistar line, one month and 10 months old — it was established that the initial stage of the clevage of glycogen in bone tissue occurred in conjunction with the amylase and phosphorylase enzymes having a predominantly hydrolytic pathway in the growing, immature animals and a phosphorylytic pathway in the older, mature animals. Generally, treatment with an 800 roentgen dose of x rays led to a significant change in the carbon metabolism in the bone resulting in the development of an anomalous build-up of glycogen which may be related to the disruption of both of the pathways of its cleavage by amylase and phosphorylase. The presence of significant age differences in the character and the dynamics of post-radiation changes in the concentration of glycogen in enzymes in the bone tissue as a result of the initial paths of its cleavage were established. (Ref. Zh.)

9173 HISTOLOGICAL STUDY OF EFFECTS OF COLLOIDAL YTTRIUM-90 ON KNEE JOINT TISSUES OF RABBITS. Pavelka, K. (Univ., Basel); Meier-Ruge, W.; Mueller, W.; Fredrich, R. Ann. Rheum. Dis.; 34: No. 1, 64-69(Feb 1975).

The administration of 0.2 to 0.4 mCi ^{90}Y into a normal rabbit knee joint fails to induce medical synovectomy and results in the proliferation of the synovialis. The synovial mesothelium shows early radiation damage but subsequently follows a restitution of the whole. Later (within 4 to 16 weeks) an extensive fibrosis of the stratum synovialis develops, as well as an occlusion and sclerosis of small synovial vessels and capillaries. These changes explain the beneficial therapeutic effect of ^{90}Y in a chronic inflammatory joint effusion. After irradiation the joint cartilage shows an increased cellular proliferation of the superficial tangential cells and in the vicinity of the cruciate ligaments small foci of degenerated cartilage are present. The overall pattern of a joint treated with intra-articular ^{90}Y corresponds to the histological pattern encountered regularly in joints of older people. Changes of the cartilage after the ^{90}Y radiation could represent a factor predisposing the treated joint to a subsequent development of osteoarthrosis. (auth)

9174 BILE SECRETING FUNCTION OF THE LIVER IN ANIMALS DURING EXPOSURE TO X RAYS. Lipov, G. N. Eksp. Klin. Radiol.; 9: 155-158(1973). (In Russian).

In experiments on six dogs having a fistula of the gall bladder and 40 adult white rats, it was demonstrated that during a general radiation treatment there was an increase in the intensity of the bile secretion and a change in its chemical composition and properties. The concentration of water in the bile increased and solid material, especially organic, precipitated. Disruption of the bile forming function of the liver in the dogs caused an increase in the filtration process apparently in connection with an increase in the permeability of the liver membrane and in the rats it was connected with a natural secretion as a result of which the precipitation of bile, acids, and hematoidin increased. (Ref. Zh.)

9175 CONTROL OF LOCAL TUMOR GROWTH WITH COMBINED FRACTIONATED RADIOTHERAPEUTIC AND CHEMOTHERAPEUTIC REGIMENS. Poulakos, L.; Schenken, L. L.; Hagemann, R. F.; Burholt, D. R.; Lesher, S. (Allegheny General Hospital, Pittsburgh). J. Natl. Cancer Inst.; 54: No. 5, 1103-1105(May 1975).

A treatment concept for the control of alcol tumor growth utilized weekday radiotherapy and weekend chemotherapy. Mice were given sc injections of P815X2 mastocytoma cells on the lower back (day 0) and separated into the following treatment groups: 5-day/week irradiation, adriamycin alone at either 5 mg/kg body wt (days 6 and 13) or 2 mg/kg (days 5, 12, and 19), and combined radiotherapy and chemotherapy. Untreated controls had a mean tumor volume of 2.77 cm^3 and a mean survival time of 24 days. Adriamycin alone at 5 mg/kg resulted in an eventual tumor volume of 70 percent of the control value at death, whereas at 2 mg/kg the tumor volume was 60 percent of control. After radiotherapy only, tumor size was 52 percent of control. Irradiation plus either 5 or 2 mg drug per kg body wt resulted in tumor volumes of 23 and 30 percent, respectively, of control values. Although no treatment regimen prolonged survival, the marked reduction in local tumor growth with combination therapy indicates that it may be a useful concept in future cancer therapy. (auth)

9176 EFFECT OF ANTITHYMOCYTE GLOBULIN PRETREATMENT ON IMMUNOLOGICAL RECONSTITUTION OF LETHALLY IRRADIATED ANIMALS. Allen, E. M.; Gengozian, N. (Oak Ridge Associated Universities, TN). Transplantation; 19: No. 6, 456-463(Jun 1975).

Clinical and experimental studies have shown that antithymocyte globulin pretreatment will reduce the severity of the graft-versus-host reaction after allogeneic bone marrow transplantation. To determine whether this was attributable to a persisting cytotoxic factor in the recipients' sera or a result of the masking of foreign antigens by the antithymocyte globulin, an experimental schema utilizing a syngeneic transfer of immunocompetent cells was devised. Lethally irradiated mice that had been pretreated with rabbit antimouse thymocyte globulin (RAMTG) were injected with syngeneic spleen or bone marrow cells and their immunological competence was measured by the response to a test antigen, sheep red blood cells. It was found that such pretreatment had an adverse effect on the immunological potential of the infused cells. Thus, the plaque-forming cell response to sheep red blood cell antigen in RAMTG-pretreated recipients injected with spleen cells was reduced when compared to the saline or normal rabbit globulin-treated controls. The immunological recovery of lethally irradiated animals protected with syngeneic bone marrow was also delayed, but not permanently impaired, when the recipients had been pretreated with RAMTG. These effects were evident although the spleen or bone marrow cells had been injected into the RAMTG-pretreated recipients at a time when their sera were devoid of any cytotoxic antibodies. It is speculated that two mechanisms may contribute to this alteration in immune function of the infused cells: (1) that RAMTG exists in the serum in amounts sufficient to attach to receptor sites on lymphocytes or their precursors but insufficient to kill the cells, interfering with the antigen recognition mechanism or migration and homing patterns, or (2) that the RAMTG treatment creates a temporary defect in the microenvironment of the spleen and other hemopoietic tissues, thereby affecting the transplantation and proliferation kinetics of the infused cells. (auth)

9177 DEFORMITIES OF THE EYE IN MICE INDUCED BY IRRADIATION. Christensen, N. (Righospitalet, Copenhagen). Ugeskr. Laeger; 137-11: No. 11, 615-617(1975). (In Dutch).

A brief review is presented of an extensive experimental investigation of deformities of the eye in mice induced by irradiation in doses of 55 R to 222 R. Varying doses were administered at different times in pregnancy and the macroscopic and microscopic morphology of the deformities were assessed. It is concluded that the defects are pathologically-anatomically well-defined and that the majority are stage-specific and are induced with increasing frequency with increasing dosage levels. Isolated defects can, however, be produced in the same morphological form with the greatest incidence at the next highest dosage level investigated. (DE)

9178 EFFECT OF X IRRADIATION ON THE BIOCHEMICAL MATURATION OF RAT CEREBELLUM: METABOLISM OF [^{14}C] GLUCOSE AND [^{14}C]ACETATE. Patel, A. J.; Balazs, R. (Medical Research Council Developmental Neurobiology Unit, Surrey, Eng.). Radiat. Res.; 62; No. 3, 456-469(Jun 1975).

The effect was studied of selective x-irradiation of the cerebellum (100 R daily in the first 10 days after birth) on the maturation of glucose metabolism and the development of metabolic compartmentation, in 10-, 16-, and 23-day-old rats by using, respectively, [2-^{14}C]glucose and [1-^{14}C] acetate (40 mu Ci/100 g body weight each) as precursors. At day 10 significant changes, in comparison with the unirradiated controls, were observed: aspartate and gamma-aminobutyrate, respectively, contained 36 percent and 64 percent more and glutamine 42 percent less glucose-carbon combined in amino acids; the glutamine/glutamate specific radioactivity ratio (RSA) was 25 percent less, and the conversion of both glucose and acetate carbons into acid-insoluble constituents was markedly reduced. However, in the postirradiation period both the conversion of glucose carbon into amino acids, and the RSA of glutamine after the administration of [^{14}C]acetate increased in a more or less normal fashion, although certain quantitative differences were noted. It seems, therefore, that the normal progress of biochemical differentiation was only affected to a small degree by the irradiation of the cerebellum, although the treatment interfered severely with cell proliferation. (auth)

9179 EFFECT OF X IRRADIATION ON THE BIOCHEMICAL MATURATION OF RAT CEREBELLUM: POSTNATAL CELL FORMATION. Patel, A. J. (Medical Research Council Development Neurobiology Unit, Surrey, Eng.); Balazs, R.; Altman, J.; Anderson, W. J. Radiat. Res.; 62: No. 3, 470-477(Jun 1975).

Rat cerebellum was irradiated with 100 R daily doses from birth to 10 days of age, and the animals were studied during the next 13

days. The growth of the body and of the forebrain were little affected, but that of the cerebellum was severely retarded. This was primarily due to a depression in new cell acquisition which during the irradiation period was only about 10 percent of that in the controls. On the other hand, it seems that the development of cells formed prior to irradiation was little affected; at day 10, the average size and the RNA and protein contents of the cells were significantly higher than at birth and they were more than double the values observed in the control. However, cell formation was not irreversibly affected: in the fortnight after the termination of irradiation the rise in cell numbers was more than 80 percent of that occurring in the control rats. A relatively normal development of the cerebellar cortex was indicated by the finding that the molecular and the internal granular layers increased substantially in size during the postirradiation period. Further, by 23 days of age the external granular layer, which is a main germinal site in the cerebellum disappeared, as in controls, and the concentration of DNA (packing density of cells) and the cellular contents of RNA and protein were normal. However, restitution was not complete: at 23 days of age, in comparison with controls, the weight of the cerebellum was 60 percent and the reduction in the total number of cells (-40 percent) was similar to the reduction in size of the internal granular layer, which contains the highest concentration of nerve cells in the cerebellum. (auth)

9180 EFFECT OF A 24-HOUR FRACTIONATION INTERVAL ON THE INDUCTION OF RAT SKIN TUMORS BY ELECTRON RADIATION. Burns, F. J.; Albert, R. E.; Sinclair, I. P.; Vanderlaan, M. (New York Univ.). Radiat. Res.; 62: No. 3, 478-487(Jun 1975).

Tumor incidence and hair follicle lethality in rat skin were determined after various single and split doses of monoenergetic electrons produced by a Van de Graaff accelerator. In the split-dose groups, an initial dose of 1000 rads was followed 24 hr later by graded doses from 1000 rads to 4000 rads. The cumulative number of tumors per rat increased steadily in all groups consistent with a linear dependence on time after a somewhat variable tumor-free period. Hair-follicle survival was determined at death of the animal and dose displacement of the response curves was equivalent to about 80 percent of the initial dose. The curve of tumor response at 70 wk versus dose was peaked, but the ascending limbs of the curves were displaced by at least 70 percent of the initial dose. It was concluded that oncogenic recovery was too rigid for cell repopulation to be significantly involved and that most, if not all the observed recovery was based on a relatively rapid process similar to Elkind recovery. (auth)

9181 RELATIVE RADIOSENSITIVITY OF RAT LENSES AS A FUNCTION OF AGE. Merriam, G. R. Jr.; Szechter, A. (Columbia Univ., New York). Radiat. Res.; 62: No. 3, 488-497(Jun 1975).

The effect of age on the development of radiation cataracts in rat lenses has been investigated using the Columbia–Sherman rat as an experiment model. A detailed pattern of age dependence was obtained at several different dose levels. In general at dose levels from 200 to 300 rads the lens changes occurred sooner and progressed faster in the adult lenses than in young lenses. In the dose range from 300 rads to 900 rads opacities developed sooner in the young lenses but progression was faster and severe opacities developed sooner in adult lenses. Above 900 rads opacities developed sooner and progressed faster in the young lenses. (auth)

9182 EFFECT OF GAMMA IRRADIATION ON THE MITOCHONDRIA AND LYSOSOMES OF CHICK EMBRYOS LIVER. Todorov, B. N. Sofia; Akademiya na Selskostopanskite Nauki (1974). vp. (In Bulgarian). INIS.

Thesis.

The structural and metabolic changes in mitochondria and lysosomes in the liver of chick embryos and chickens irradiated with 3 and 1000 rad, were investigated. That there were changes in the stability of these organoids was judged by the changes in the free activity of the enzymes characteristic for mitochondria (malate dehydrogenase – MDH, glutamate dehydrogenase – GLDH) and for lysosomes (acid phosphatase – AP) as well as by the changes in the content of NAD and NADH. Eggs of white leghorn were used and were studied at 1st, 24th, and 72nd h after irradiation in the following groups: 12, 20, 21 day old embryos and 7 day old chickens. The embryos and chickens irradiated with 1000 rad showed drastically quick alterations in the ultrastructure of their mitochondria and later in their lysosomes. In all ages, except for the 20-day-old embryos, the free activity of MDH, GLDH, and AP increased and showed that irradiation with 1000 rad caused the liberation of the mitochondrial and lysosomal enzymes. The content of the oxidized and reduced forms in the mitochondrial fraction decreased in all ages except in the 20 day old embryos. The well-pronounced decrease in the content of adenine nucleotides after irradiation is the result primarily of the decreased concentration of ATP during the whole period of investigation. The 12-day-old embryos are the most sensitive to irradiation. The 20-day-old embryos are characterized by a well-pronounced radioresistance. In this group especially at the early stages after irradiation, there were almost no changes in the structure and function of the mitochondria and lysosomes. The evidence that the changes depend on the dose of 1000 rad is obtained from the studies of embryos and chickens irradiated with 3 rad. In the latter case no changes in the mitochondria and lysosomes were observed. In the early stages after irradiation with 1000 rad, a primary alteration of the mitochondrial structure and function was observed. Damages in the lysosomes followed as a result of an insufficiency of energy. At the same time the hydrolases were set free and penetrated the cytoplasm. The hydrolases have an additional action on the previously damaged mitochondria and this leads to more profound changes in their structure and function. (auth)

9183 INFLUENCE OF RADIOPROTECTORS ON THE CONTENT OF BIOLOGICALLY ACTIVE SUBSTANCES IN THE LIVER OF IRRADIATED ANIMALS. Kovaleva, T. A. Fiziol. Fiz.-Khim. Mekh. Regul. Obmennykh Protsessov Org.; No. 2, 62-66(1973). (In Russian).

Rats were exposed to x rays in a dose of 800 roentgens, and the content of lipid radiotoxins, quinones, and choline in the liver tissue was determined. At 2, 24, and 48 hours after exposure, the content of lipid radiotoxins increased by 20, 34, and 60% respectively, which correlated directly with the degree of hemolytic activity of the lipid radiotoxins; the content of quinones showed an increase only two hours after exposure, and the choline content did not change appreciably over the 48 hours after exposure. Preinjection of cystamine before exposure (200 mg/kg) was accompanied by a reduction of the lipid radiotoxin content in the liver by 17, 21, and 90% respectively 2, 24, and 48 hours after exposure as compared with the unprotected irradiated animals; the radioprotective action of cystamine with respect to quinones and choline showed up only in the initial period (2 hours) after exposure. It is concluded that choline is a secondary radiotoxin and does not take part in the initial trigger mechanisms of radiation disease. (Ref. Zh.)

9184 EFFECT OF ^{137}Cs GAMMA RADIATION ON ACETYLCHOLINESTERASE OF INTACT RABBIT ERYTHROCYTES IN VITRO. Bondar, A. A.; Kadykov, B. I. Sb. Rab., Leningrad. Vet. Inst.; No. 38, 18-22(1974). (In Russian).

The changes in the activity of acetylcholinesterase (I) were studied during irradiation in vitro of a suspension of rabbit erythrocytes with ^{137}Cs gamma rays in doses up to 6×10^5 rads. I exhibits considerable radioresistance. Irradiating a suspension of erythrocytes containing a number of cells per microliter equal that of the range of physiological levels, 50% inactivation of I was observed only with the dose of $4.5 \cdot 10^5$ rads. The relationship of relative activity of I and irradiation dose is exponential in character. (JPRS)

9185 DESYNCHRONIZATION OF THE DIURNAL RHYTHM OF ACID PHOSPHATASE ACTIVITY IN MALE GONADS OF MICE UNDER THE INFLUENCE OF UV AND X-RAY RADIATION. Barbacka, G.; Surowiak, J. (Uniwersytet Jagiellonski, Krakow (Poland)). Acta Biol. Cracov., Ser. Zool.; 16: 71-85(1973).

By means of histochemical and biochemical methods, acid phosphatase activity was studied in the testes of male mice in the course of 24 hours in the spring and winter seasons and different geographical longitudes, and the influence of large doses of x-ray radiation (50 kVp 20 mA, 2100 R) and uv (about 80,000 ergs/sec./cm^2) on this rhythm was observed. The findings showed that the diurnal rhythm of this enzyme is somewhat different in interstitial tissue than in the germinal epithelium of the convoluted tubules of the testes. Both types of radiation desynchronized this rhythm within several hours after exposure. Significant differences of diurnal rhythm of acid phosphatase activity were also observed in different seasons of the year and different geographical longitudes. (auth)

9186 INFLUENCE OF LARGE DOSES OF ULTRAVIOLET RADIATION ON DAILY RHYTHM OF PERIPHERAL BLOOD THROMBOCYTES IN MICE. Lach, H. (Wyzsza Szkola Pedagogiczna, Krakow (Poland)); Surowiak, J. (Uniwersytet Jagiellonski, Krakow (Poland)). Acta Biol. Cracov., Ser. Zool.; 16: 179-186 (1973).

Mice were irradiated once in the spectral range from 254 to 405 nm with energy of about 79,000 ergs/sec/cm^2 during 1 hr at 12.00, 18.00, 24.00, and 6.00 hours. Six hours after the exposure, erythrocyte and thrombocyte counts per 1 mm^3 were made in the peripheral blood of the animals. The number of thrombocytes in the blood decreased below the control values. Erythrocytes showed a rise at 18.00 hours and a drop at 6.00 hours. It was concluded that sensitivity to uv radiation is highest between the hours 6.00 and 12.00, and lowest between 18.00 and 24.00 hours. (auth)

9187 GOMORI-POSITIVE GLIA IN UV-IRRADIATED MICE. Srebro, Z. (Akademia Medyczna, Krakow (Poland)); Lach, H. (Wyzsza Szkola Pedagogiczna, Krakow (Poland)). Acta Biol. Cracov., Ser. Zool.; 16: 43-48(1973).

A single, massive dose of uv was applied to the skin of the back of adult, female albino mice. The irradiated animals were killed after 12 h, 24 h, and 48 h following the irradiation. The brains of the animals were examined histologically from preparations stained with Gomori's chrome haematoxylin method. A significant increase in number of periventricular glial cells showing Gomori-positive granulations was found in the hypothalamus of irradiated animals in comparison with unirradiated, control mice. A tendency to return towards normal level was observed 48 h post irradiation. (auth)

9188 CHEMICAL RADIOPROTECTION OF PRIMARY IMMUNE RESPONSE AFTER IRRADIATION WITH GAMMA RAYS. IV. Protection Effectiveness upon Immunization with Live Tularemic Vaccine. Sumerska, T.; Denchev, V. (Meditsinska Akademiya, Sofia (Bulgaria). Tsentyr po Zarazni i Parazitni Bolesti). Probl. Zaraznite Parazit. Boles.; 2: No. 1, 337-341 (1974). (In Bulgarian).

The possibilities are studied of chemical radioprotection of the vaccinal process upon employing live tularemic vaccine. The experimental model consists of white mice subjected to irradiation with gamma rays at doses of 300 and 400 rads. Serotonin in the form of serotonin creatinine sulfate is used as a chemical radioprotector. The agglutination titers at 3, 5, 7, and 14 days after immunization and the lethality of experimental animals are followed up. A well pronounced effect of serotonin on the primary immune response against live tularemic vaccine is established. The protection is more effective with regard to precursors of antibody synthesizing cells, than with regard to lethality. (auth)

9189 FORMATION OF PIGMENTS OF LIPID NATURE IN ANIMAL TISSUES DURING NEOPLASTIC DEVELOPMENT AND IRRADIATION. Vertushkov, V. T.; Ivanov, I. I.; Tarusov, B. N. (Moskovskij Gosudarstvennyj Univ. (USSR). Biologo-Pochvennyj Fakul'tet). Biofizika; 19: No. 2, 295-299(Mar 1974). (In Russian).

For English translation see the journal Biophysics.

Studies were carried out on the colored polymeric products formed in lipids of the spleen, blood, and bone marrow of mice and rats during malignant tumor growth after x-ray irradiation. A number of radioprotective agents, including the endogenic agents adrenaline, serotonin, and histamine, sharply accelerate lipid polymerization. It is proposed that the polymeric products of the oxidation of lipids in vivo can be considered as carcinogenic compounds of endogenous origin. (tr-INIS)

9190 SIGNIFICANCE OF THE SO CALLED ABORTIVE INCREASE OF THE LEUKOCYTES AND THE FIRST LEUKOPENIC PHASE AFTER TOTAL X-RAY IRRADIATION. Yankov, B.; Khadzhijski, L. (Vissh Voenno-Meditsinski Inst., Sofia (Bulgaria)). Voenno Med. Delo; 29: No. 4, 39-45(1974). (In Bulgarian).

Investigations were carried out about the changes of the leukocytes in 43 dogs irradiated with different doses of x rays: 200 R, 335 R, and 500 R. They have observed the following phases in the changes of the number of the leukocytes—initial leukocytosis, first leukopenic phase, abortive increase of the leukocytes, second leukopenic phase, and restorative phase. The first leukopenic phase, the abortive increase and the second leukopenic phase indicated dependence of the dose of irradiation in regard to the time of appearance degree of manifestation, and their duration. (auth)

Invertebrates

Refer also to abstracts 8989 and 9104.

9191 COLONY FORMATION OF THE WESTERN HARVESTER AND IN A CHRONIC GAMMA RADIATION FIELD. Am. Midl. Nat.; 89: No. 2, 446-448(Apr 1973).

A colony of Western harvester ants, Pogonomyrmex occidentalis, became established in a chronically exposed gamma radiation field located on the native short-grass plains of Colorado. The exposure level at the nest site was 18 R/hr. At the end of the colony's first and second seasons the nest mound diam were 25 and 36 cm, respectively. There were no apparent habitat modifications to suggest any avoidance response to the radiation. (auth)

9192 PRELIMINARY ECOLOGICAL OBSERVATIONS OF CERATITIS CAPITATA WIED. ON THE ISLAND OF PROCIDA WITH AN ATTEMPT TO CONTROL THE SPECIES USING THE STERILE-MALE TECHNIQUE. Cirio, U.; De Murtas, I. D.; Gozzo, S.; Enkerlin, D. (CNEN, Rome). Boll. Lab. Entomol. Agrar. Portici; 30: 175-188(1972). (In Italian).

This study refers to ecological data obtained on the island of Procida in an effort to effectuate a control program against Ceratitis capitata Wied. by means of distribution of irradiated sterile insects. After brief references to the environmental conditions of the research area, the species of plant hosts present on the island are listed, and the observations on their susceptibility to attack are noted. In particular, it was noted that the fruit of the sour orange tree harbor larvae and pupae of the insect even during the winter months and, in certain micro-habitats of the island, are the cause of troublesome botbeds of infestation. By using the technique of marking and recapturing adult insects, certain characteristics of the trypetid population such as the size of the population, the density, and population growth were studied. In regard to the density of the population it was observed that the population is subject to strong variations, mainly in relation to the seasonal cycles. The data obtained in regard to the population growth demonstrates that in favorable environmental conditions, Ceratitis can multiply up to 42 times from one generation to another. On the basis of this accumulated data and other considerations included, the following conclusion may be made: by using the sterile insect technique the control of Ceratitis on the island of Procida, though presenting certain difficulties as to the particular biological environment of the working site, could be satisfactorily applied if based on the ecological information obtained. (auth)

9193 INFLUENCE OF IONIZING RADIATION ON REPRODUCTION AND MORTALITY OF THE FLOUR MITE (ACARUS SIRO L.). Jonczy, J. (Uniwersytet Jagiellonski, Krakow (Poland)). Folia Biol. (Krakow); 21: 77-84(1973).

Eggs and populations of the flour mite (Acarus siro L.) were irradiated with soft x rays and gamma rays. Doses up to 100,000 R of x rays had no visible effect on populations whereas a dose of 60,000 R inhibited hatching of the treated eggs completely. The following lethal and sterilizing doses of gamma radiation were determined for eggs and whole populations: lethal dose for eggs—20,000 roentgens; absolute lethal dose (ALD) for population—200,000 R within 15 days, 150,000 R within 30 days, 100,000 R within 60 days; sterilizing dose for eggs—10,000 R (individuals which hatched from eggs exposed to this dosage were sterile); and sterilizing dose for population—60,000 R. Low dosages, up to 5,000 R of x rays and 2,000 R of gamma rays, had a stimulating influence on eggs and populations of the flour mite. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 8909—8910, 9120, 9221, and 9226.

9194 (BNWL-1950(Pt. 1), pp 71-73) MOLECULAR HYBRIDIZATION: DEVELOPMENT OF METHODOLOGY FOR INVESTIGATING MECHANISMS OF PLUTONIUM INDUCED NEOPLASIAS. Frazier, M. E. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The method for making tritium-labeling DNA copies from oncornaviruses is described as are the means for removing normal host sequences that may have been copied. Several probes have been made, from known oncornaviruses, and these probes have been checked for specificity of the reaction. (auth)

9195 (ORNL-TM-4762) RADIOLOGICAL ASSESSMENT OF RADIONUCLIDES IN LIQUID EFFLUENTS OF LIGHT WATER NUCLEAR POWER STATIONS. Booth, R. S.; Kaye, S. V.; Rohwer, P. S. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 52p. Dep. NTIS $5.75.

Considerable experience has been accumulated in assessing the impact of radionuclides released into the environment, particularly in the last few years when environmental impact statements were produced by the U.S. Atomic Energy Commission. This report summarizes work done by the authors on sections of these impact statements which consider radionuclides released in the liquid effluents of light-water power reactors. The details of our calculational procedure and the range for the doses we calculated are presented here in the form of a generic report. We have not specified particular radionuclide release rates or environmental conditions. Rather, typical release rates are used and the most important environment parameters have been incorporated into dose equations. Doses were calculated for reasonable ranges in these environmental parameters to determine the expected variability of these doses caused by variability in the environment. These tabulated results are factors by which one can convert a radionuclide

release to a potential dose once values for the key environmental parameters have been determined. The tabulated results can also be used to verify doses that have already been calculated. This report complements and supplements information incorporated into the widely used maximum permissible concentrations of radionuclides in water, (MPC)/sub w/. We feel that the (MPC)/sub w/'s are inadequate indexes of the significance of radionuclide concentration in the environment because they apply only to the pathway of water ingestion by man. (auth)

9196 PLUTONIUM PARTICLES: SOME LIKE THEM HOT. Lovins, A. B.; Patterson, W. C. Nature (London).; 254: No. 5498, 278-280(27 Mar 1975).

A discussion is presented on the relative hazards of Pu in the form of hot particles deposited in the lungs and the same activity uniformly distributed, and also on whether currently recommended standards for inhalation of Pu are seriously in error. Reference is made to the Medical Research Council's 1975 report on the Toxicity of Pu (see Nature 253:385(1975)) which concludes that there is no evidence of any difference; a similar conclusion is reached in Report R.29 (1974) of the National Radiological Protection Board. Reference is also made to an article by Tamplin in the New Scientist of March 20th 1975, in which it is stated that Pu exposure standards must eventually be made more restrictive by a factor approaching 1000. Behind this disagreement is a major controversy over the risk of lung cancer from inhaled insoluble particles of intensely radioactive α-emitters. It is stated that in this controversy, which is unresolved by any direct data, lies a source of uncertainty about the future of nuclear power. (UK)

9197 ACUTE KNEE JOINT RUPTURE AFTER YTTRIUM 90 INJECTION. Davis, P.; Jayson, M. I. V. (Univ. of Bristol, Eng.). Ann. Rheum. Dis.; 34: No. 1, 62-63(Feb 1975).

Two cases of acute rupture of the knee joint are reported after the intra-articular injection of radioactive ^{90}Y. It is suggested that this may be a complication of intra-articular radioactive injections. (auth)

9198 HEALTH AND SAFETY AND THE NUCLEAR INDUSTRY. Mummery, P. W. (British Nuclear Fuels Ltd., Windscale, Eng.). Atom (London); No. 221, 40-41(Mar 1975).

A resume is given of a Press Conference held at the Windscale reprocessing plant of British Nuclear Fuels Ltd. on 30th January 1975 on health and safety and radiation standards with regard to personnel and people living in the neighbourhood. (UK)

9199 METASTASISING CARCINOMA OF THE RENAL PELVIS AFTER THOROTRAST PYELOGRAPHY. Tschubel, K.; Helpap, B. (Bonn Univ. (F. R. Germany). Pathologisches Inst.); Boldt, I. (Bonn Univ. (F. R. Germany). Radiologische Klinik); Bastian, P. (Bonn Univ. (F. R. Germany). Urologische Klinik). Fortschr. Geb. Roentgenstr. Nuklearmed.; 122: No. 2, 103-105(Feb 1975). (In German).

A carcinoma of the renal pelvis was diagnosed in a female patient 42 years after a retrograde Thorotrast pyelogram. The patient died as a result of the carcinoma at the age of 60. The literature is reviewed. As a result of this case, the need is stressed for early recognition of Thorotrast depositis in the kidney. In this case it was demonstrated by autoradiography. Appropriate treatment is discussed. (auth)

9200 BORON NEUTRON CAPTURE THERAPY FOR THE TREATMENT OF CEREBRAL GLIOMAS. I: THEORETICAL EVALUATION OF THE EFFICACY OF VARIOUS NEUTRON BEAMS. Zamenhof, R.G. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Murray, B.W.; Brownell, G.L.; Wellum, G.R.; Tolpin, E.I. Med. Phys. 2: No. 2, 47-60 (Mar 1975).

The technique of boron neutron capture therapy in the treatment of cerebral gliomas depends upon the selective loading of the tumor with a ^{10}B-enriched compound and subsequent irradiation of the brain with low-energy neutrons. The charged particles produced in the ^{10}B (n,α) ^{7}Li reaction have ranges in tissue of less than 10 μm so that the dose distribution closely follows the ^{10}B distribution even to the cellular level. The effectiveness of this therapy procedure is dependent not only on the ^{10}B compound but on the spectral characteristics of the neutron source as well. Hence, an optimization of these characteristics will increase the chances of therapeutic success. Transport calculations using a neutral particle transport code have been made to determine the dose-depth distributions within a simple head phantom for five different incident neutron beams. Comparison of these beams to determine their relative therapeutic efficacy was made by the use of a maximum useable depth criterion. In particular, with presently available compounds, the MIT reactor (MITR) therapy beam (a) is not inferior to a pure thermal neutron beam, (b) would be marginally improved if its gamma-ray contamination were eliminated, (c) is superior to a partially ^{10}B-filtered MITR beam, and (d) produces a maximum useable depth which is strongly dependent upon the tumor-to-blood ratio of ^{10}B concentrations and weakly dependent upon the absolute ^{10}B concentration in tumor. A pure epithermal neutron beam with a mean energy of 37 eV is shown to have close to the optimal characteristics for boron neutron capture therapy. Furthermore, these optimal characteristics can be approximated by a judiciously D_2O moderated and ^{10}B-filtered ^{252}Cf neutron source. This tailored ^{252}Cf source would have at least a 1.5 cm greater maximum useable depth than the MITR therapy beam for realistic ^{10}B concentrations. However, at least one gram of ^{252}Cf would be needed to make this a practical therapy source. If the moderated ^{252}Cf source is not ^{10}B filtered, the resultant neutron beam has characteristics similar to those of the MITR beam with no gamma-ray contamination. For such a beam, 100 mg of ^{252}Cf would produce a flux of 2.4×10^{8} neutrons/(cm^2 sec), which is an intensity suitable for therapy applications. (auth)

Animals

Refer also to abstracts 9162, 9227, 9229, 9232–9233, 9239, 9241, 9243, and 9252.

9201 (BNWL-1950(Pt. 1), pp 3-9) DOSE-FFFECT STUDIES WITH INHALED PLUTONIUM OXIDE IN BEAGLES. Park, J. F.; Buschbom, R. L.; Catt, D. L.; Craig, D. K.; Dagle, G. E.; Hackett, P. L.; Powers, G. J.; Ragan, H. A.; Watson, C. R. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Beagle dogs given single exposure to $^{239}PuO_2$ or $^{238}Pu^{16}O_2$ aerosols are being observed for life-span dose-effect relationships. The ^{239}Pu body burden of the nine dogs dying due to respiratory insufficiency during the first 3 years after exposure was 1 to 12 mu Ci. One of these dogs had a pulmonary tumor. None of the dogs exposed to ^{238}Pu died during the first postexposure year. After inhalation of $^{239}PuO_2$ or $^{238}PuO_2$ lymphocytopenia was the earliest observed effect, occurring 0.5 to 2 years after deposition of greater than or equal to 80 nCi plutonium in the lungs. (auth)

9202 (BNWL-1950(Pt. 1), pp 10-16) LATE EFFECTS OF INHALED $^{238}PuO_2$ IN BEAGLES. Park, J. F.; Catt, D. L.; Hackett, P. L.; Lund, J. E.; Powers, G. J.; Ragan, H. A.; Watson, C. R. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Bone tumors were the primary cause of death in beagle dogs 4 to 6 years after inhalation of $^{238}PuO_2$. The plutonium body burden at death ranged from 0.5 to 2.6 mu Ci with 32 to 55 percent of the plutonium in the skeleton. Pulmonary neoplasia was observed in three of the bone-tumor-bearing dogs. (auth)

9203 (BNWL-1950(Pt. 1), pp 22-23) CARCINOGENICITY OF INTRATRACHEALLY INSTILLED $^{239}PuO_2$ AND ASBESTOS IN RATS. Sanders, C. L. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Immobilization and concentration of $^{239}PuO_2$ in asbestos-induced scar tissue in peribronchiolar regions of the rat lung reduce the incidence of lung tumors. No mesotheliomas were observed. (auth)

9204 (BNWL-1950(Pt. 1), pp 38-40) LONG-TERM EFFECTS OF INTRATRACHEALLY INSTILLED $^{253}EsCl_3$ IN RATS. Ballou, J. E.; Dagle, G. E.; Morrow, W. G. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Rats administered $^{253}EsCl_3$ by intratracheal instillation developed more bone tumors and fewer lung tumors than similar rats administered $^{239}Pu(NO_3)_4$. In explanation, it is suggested that ^{253}Es may irradiate bone surface cells more effectively while ^{239}Pu may irradiate a greater total number of cells in the lung. (auth)

9205 (BNWL-1950(Pt. 1), pp 43-46) LONG-TERM EFFECTS OF INHALED $Pu(NO_3)_4$ AND $Es(NO_3)_3$ IN RATS. Ballou, J. E., Dagle, G. E. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Ongoing studies with rats exposed to a wide range of lung burdens of inhaled $^{239}Pu(NO_3)_4$, $^{238}Pu(NO_3)_4$, and $^{253}Es(NO_3)_3$ show little effect on weight gain; the highest dose levels significantly affect survival.

Information on the long-term carcinogenic effects is not yet available. (auth)

9206 (BNWL-1950(Pt. 1), pp 74) EFFECTS OF PLUTONIUM ON THE IMMUNE SYSTEM: IgG IN BEAGLE DOGS EXPOSED TO PLUTONIUM AND IN NONEXPOSED CONTROLS. Hadley, J. G.; Morris, J. E. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Serum IgG levels in plutonium-oxide-exposed and unexposed beagle dogs were assayed with the Mancini system. With this system, there was no significant difference between IgG levels of exposed dogs and controls, nor among exposed dogs with different degrees of lymphopenia. (auth)

9207 (BNWL-1950(Pt. 1), pp 75) SIMPLE METHOD FOR THE ISOLATION OF CANINE IgM FROM NORMAL SERUM. Morris, J. F. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

A simple system is described for the purification and partial characterization of canine IgM from serum. (auth)

9208 (BNWL-1950(Pt. 1), pp 85-86) EFFECTS OF ^{253}Es INJECTED IN WEANLING AND ADULT RATS. Mahlum, D. D.; Sikov, M. R.; Hungate, F. P. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Weanling and adult Wistar and adult Fischer rats were intravenously injected with ^{253}Es and observed until death or to 30 months of age. In the adult Wistars there was a peak incidence of bone tumors at about 5.0 mu Ci/kg with a lower rate at higher doses, but in the weanlings the incidence continued to increase up to 100 mu Ci/kg. Bone tumor incidence in the Fischer rat tended to be lower than in the Wistar strain. (auth)

9209 (BNWL-1950(Pt. 1), pp 97-101) EFFECTS OF CHRONIC ^{90}Sr INGESTION IN MINIATURE SWINE. Ragan, H. A.; Hackett, P. L.; Lund, J. E.; McClanahan, B. J. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Daily ^{90}Sr feeding of greater than 125 mu Ci/day resulted in pancytopenia with death usually due to hemorrhage. At 125 mu Ci, pancytopenia and myelolymphoproliferative disorders appeared. At less than 125 mu Ci/day a dose-related neutropenia was evident. There is an apparent increased incidence of both benign and malignant tumors of soft tissue in animals fed 25 mu Ci/day for their lifetime. Benign uterine tumors, dental defects and marked arthritis continued to be the major diseases necessitating euthanasia in aged animals from all groups, including control swine. (auth)

9210 (BNWL-1950(Pt. 1), pp 111-114) ACUTE TOXICITY OF INGESTED RUTHENIUM-106. Sullivan, M. F.; Ruemmler, P. S. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The median lethal ingested dose of ^{106}Ru for adult, weanling, and newborn rats was about 9, 20, and 2 mCi/kg, respectively. Death from gastrointestinal damage in dogs occurred at doses between 3.5 and 4.0 mCi/kg. Death was usually caused by severe damage to the lower bowel where the radiation dose was highest due to the prolonged residence time in that segment. Incorporation of ^{106}Ru in the epithelium of the small intestine of the newborn contributed to the sensitivity of that age group. (auth)

9211 (BNWL-1950(Pt. 1), pp 117-120) BIOLOGICAL EFFECTS IN BEAGLE DOGS OF INHALED RADON DAUGHTERS, URANIUM ORE DUST, AND CIGARETTE SMOKE. Palmer, R. F.; Filipy, R. E.; Stuart, B. O.; Hackett, P.; Ragan, H. A.; McDonald, K. E. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

After 5 years of daily inhalation exposures to 600 WL radon daughters plus uranium ore dust and/or cigarette smoking, observed pulmonary lesions include macrophage proliferation, septal fibrosis, epithelial hyperplasia, emphysema, endothelial proliferation, and bronchiolar-alveolar epithelial changes involving multiple foci of squamous metaplasia with atypia. Epithelial neoplasms were found in the respiratory tracts of three dogs. (auth)

9212 (BNWL-1950(Pt. 1), pp 121) DISPOSITION OF LONG-LIVED URANIUM CHAIN ALPHA EMITTERS FOLLOWING REPEATED INHALATION EXPOSURES OF BEAGLE DOGS TO URANIUM ORE AND RADON DAUGHTERS. Palmer, R. F.; Jackson, P. O.; Stuart, B. O. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Thorium-230 was found to separate readily in vivo from parent uranium, following long-term inhalation of carnotite uranium ore by beagle dogs. Thorium-230 should be considered as an individual hazard in uranium mining and milling operations. (auth)

9213 (BNWL-1950(Pt. 1), pp 122-123) COMPARATIVE EFFECTS IN HAMSTERS, RATS, AND MICE OF EXPOSURE TO SIMULATED URANIUM MINE ATMOSPHERES. Palmer, R. F.; Filipy, R. E.; Stuart, B. O. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Hamsters, rats, and mice were chronically exposed to radon daughters, with and without uranium ore dust, to provide an interspecies comparison of the effects of these uranium mine inhalation hazards. (auth)

9214 (BNWL-1950(Pt. 1), pp 135-136) LONG-TERM EFFECTS OF INHALED Ca-DTPA IN RATS PREVIOUSLY EXPOSED TO $^{239}Pu(NO_3)_4$ AEROSOLS. Ballou, J. E.; Dagle, G. E.; Buschbom, R. L. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Inhaled Ca-DTPA given 20 days after $^{239}Pu(NO_3)_4$ inhalation was marginally effective (p equals 0.10) in reducing the amount of Pu in rat lung. This reduction in Pu lung burden did not, however, affect the later induction of lung tumors. An increased osteosarcoma incidence was noted in control rats exposed only to nitric acid aerosols. Complete tumor incidence data are not yet available. (auth)

9215 (BNWL-1950(Pt. 1), pp 164-165) VIRAL AND MOLECULAR ASPECTS OF RADIATION (^{90}Sr)-INDUCED LEUKEMIA IN MINIATURE SWINE. Frazier, M. E.; Morris, J. E. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Biochemical evidence of oncornavirus infection has been found in the spleens of irradiated miniature swine (both leukemic and nonleukemic) but not in spleens from normal unirradiated miniature swine. In the spleens from irradiated swine, we have demonstrated a true RNA-instructed DNA polymerase (RIDP). Using this RIDP we have generated tritium-labeled DNA probes of high specificity which can now be used in hybridization studies to examine the molecular pathology of radiation-induced leukemia of swine. (auth)

9216 (BNWL-SA-5237) SUPPRESSION OF THE PRIMARY IMMUNE RESPONSE IN RAINBOW TROUT, SALMO GAIRDNERI, SUBLETHALLY IRRADIATED DURING EMBRYOGENESIS. Strand, J. A.; Fujihara, M. P.; Burdett, R. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1975. 7p. (CONF-750503-20). Dep. NTIS $4.00.

From 4th national symposium on radioecology; Corvallis, Oregon, USA (12 May 1975).

Eggs of rainbow trout were spawned artificially in the laboratory, fertilized, and immediately immersed in 0, 0.01, 0.1, 1.0, and 10.0 mu Ci/ml tritium (biological grade) contaminated spring water (pathogen free). Rearing through 20 days of embryogenesis at 10.5 +- 0.2°C was facilitated within a recirculation drip incubation system of 150 liter capacity. Exposure of the embryos to 0, 0.01, 0.1, 1.0, and 10.0 mu Ci/ml tritium resulted in an estimated total dose of 0, 0.048, 0.470, 4.550, and 40.348 rads. At 5 months post hatch, control and irradiated test fish were administered intraperitoneally 0.1 cc of a heat killed antigen (1.8×10^8 cells per ml, Chondrococcus columnaris) in 25 percent

Freund's incomplete adjuvant. A 0.1 cc sham vaccination containing saline and 25 percent Freund's incomplete adjuvant was similarly administered to another group of control fish. At 3 weeks post vaccination and at weekly intervals thereafter, a standard tube agglutination test for the specific antigen of vaccination was performed on serum from each fish. Results showed a marked suppression of the primary immune response in fish irradiated at the 4,550 and 40,348 rad levels. (CH)

9217 CHROMOSOMAL ABERRATIONS IN RATS FED IRRADIATED WHEAT. Vijayalaxmi; Sadasivan, G. (Indian Council of Medical Research, Hyderabad). Int. J. Radiat. Biol.; 27: No. 2, 135-142(Feb 1975).

The effects on chromosomal aberrations in bone-marrow cells of feeding irradiated wheat to well-fed and malnourished rats were investigated. Rats maintained on low levels of dietary protein (5 per cent) had a higher incidence of breaks and deletions in their bone-marrow chromosomes compared with rats maintained on adequate levels of protein (18 per cent), showing that the level of dietary protein per se can produce structural abnormalities. Feeding of irradiated wheat to rats was associated with an increase in the number of polyploid cells in the bone-marrow. The level of protein in the diet did not appear to influence polyploidy. (auth)

Nuclide Kinetics and Toxicology

Man

9218 (BNWL-1950(Pt. 1), pp 127-129) EVALUATION OF POSTMORTEM TISSUE SAMPLES. Nelson, I. C.; Kirby, L. J.; Swinth, K. L.; Thomas, V. W. Jr. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Radiochemical analysis of postmortem samples of lung, liver, bone, lymph nodes, and other tissues from individuals residing in the vicinity of the Hanford Project was carried out. Tissue samples were analyzed for the U. S. Transuranium Registry (USTR). Plutonium analyses were performed on samples obtained from the USTR. Improvements were made in the radiochemical procedure used to separate and measure the plutonium content of tissue samples. Results of analyses are presented. Procedures were developed for analysis of uranium in tissues from former workers exposed to uranium. (HLW)

9219 ENZYMATIC INHIBITION OF DIPHOSPHONATE: A PROPOSED MECHANISM OF TISSUE UPTAKE. Zimmer, A. M.; Isitman, A. T.; Holmes, R. A. (Medical Coll. of Wisconsin, Milwaukee). J. Nucl. Med.; 16: No. 5, 352-356(May 1975).

Enzymes have been proposed as tissue receptors that bind /sup 99m/Tc-stannous diphosphonate and its analogs. Incubation of diphosphonate with several enzymes demonstrated inhibition of acid and alkaline phosphatase activity but showed no effect on glutamic transaminase and lactate dehydrogenase activity. Complete reversal of the diphosphonate-induced inhibition of alkaline phosphatase activity occurred when calcium ion was added to the reaction. The specificity of calcium to induce reversal was dispelled when magnesium ion gave identical results. Diphosphonate-induced inhibition of acid phosphatase, however, was not reversed by calcium or magnesium. (auth)

9220 SPONTANEOUS NUCLEAR FISSION AND DECOMPRESSION ILLNESS. Lancet; 1: No. 7910, 787(5 Apr 1975).

The occurrence and etiology of decompression sickness in divers and compressed air workers are reviewed. The spontaneous in vivo disintegration of uranium-238 provides one suggested source of micronuclei for bubble formation (Walder, D. N., Evans, A., Nature, 1974, 252, 696), but their discussion of the implications was incomplete. These authors proposed that the frequency of spontaneous fission during exposure to raised environmental pressure may be related quantitatively to the incidence of decompression sickness in compressed air workers. Their discussion on bends-rates did not however allow for the increased rate of decompression sickness to be expected after exposure to higher environmental pressures, nor for the observation that the incidence of decompression sickness was not necessarily the same as the incidence of bubble formation. Bends-rates greater than the predicted fission rate may be ascribed to micronuclei of a more stable variety, which would survive compression, accumulating between exposures to raised environmental pressures. The fundamental idea that spontaneous nuclear disintegration in vivo provides a source of micronuclei in the etiology of decompression sickness, and possibly of dysbaric osteonecrosis, is still worth serious consideration. (UK)

9221 PROTECTION PROBLEMS IN RADIONUCLIDE THERAPY: THE PATIENT AS A GAMMA-RADIATION SOURCE. Pochin, E. E.; Kermode, J. C. (Medical Research Council, London). Br. J. Radiol.; 48: No. 568, 299-305(Apr 1975).

Estimates have been made of the rate of uptake, metabolism, and excretion of radioiodine given in treatments of patients with hyperthyroidism or thyroid carcinoma. Average values for the exposures to be expected at a given distance from such patients, and the variability of such exposures, were derived from these data. The mean exposure of a patient in an adjacent bed, at 2.5 m bed spacing, following typical therapeutic doses of ^{131}I in the treatment of hyperthyroidism or thyroid carcinoma, was estimated to be about 0.02 or 0.08 R respectively. Variations in the metabolic parameters would increase these exposures to about 0.03 and 0.14 R, at the 90 percentile values. Exposures following treatments with 100 mCi of ^{198}Au, or of 300 mg days of ^{226}Ra would be about 0.2 and 0.6 R. (auth)

9222 USE AND LIMITATIONS OF DTPA TO REMOVE PLUTONIUM. Smith, H. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 11, 15-16(Apr 1975).

Diethylenetriaminepentaacetic acid (DTPA) has been used in the treatment of cases of internal contamination with plutonium where the level of intake justified therapy. One major limitation of DTPA is that it does not penetrate cells readily. The effectiveness of DTPA depended therefore upon that fraction of the original intake of plutonium which was present in the blood or extracellular fluid at the time of treatment. However, DTPA has been shown to be partially effective as intermittent therapy over days or weeks if a slow leaching of non-transportable or insoluble plutonium was occurring into the blood from lung or wound sites. Different treatment regimens in use in the U. K. and U. S. are briefly described, together with the use of a solution of DTPA for wound decontamination. A major limitation on the use of DTPA is that it has not so far been recognised as an approved (i.e. safe) drug by regulatory bodies in the U.K. or U.S., and so it is only available now as an experimental drug. No toxic effects have been reported in the human where recommended doses were not exceeded, but the observation that administration of the calcium salt of DTPA caused enhanced excretion of the essential trace element zinc in animals could be significant. Injection of the zinc salt, rather than the calcium salt, could avoid this effect. In spite of these limitations, DTPA remains the best available treatment for removing plutonium. (UK)

9223 ISOTOPE STUDIES ON THE UPTAKE AND RELEASE OF IONS BY DENTAL ENAMEL. Tetteh, G. K. (Univ. of Ghana, Legon). Caries Res.; 8: 224-233(1974).

The uptake and release of sodium, orthophosphate, calcium, and strontium from human dental enamel have been studied using radioactive techniques. The uptake of these elements were found to be both hetero-ionic and iso-ionic, but preferentially iso-ionic in the case of sodium, orthophosphate and strontium. However, the uptake of calcium was preferentially hetero-ionic. Also strontium was not observed to be permanently taken up by dental enamel. Strontium in dental enamel could exchange with either strontium or calcium in the surrounding solution at practically the same rate. (auth)

9224 BEHAVIOR OF RADIOACTIVE COLLOIDAL GOLD CLEARANCE IN HEPATIC CIRRHOSIS TREATED WITH ALPHA-MERCAPTOPROPIONYL GLYCINE. Bertoli, L.; Banfi, F.; Conti, F. (Ospedale Maggiore, di Milan). Minerva Med.; 65: 830-833(28 Feb 1974). (In Italian).

Hepatic sinusoidal perfusion flow on admission and after not less than 35 days in 16 cirrhosis patients treated with α-mercaptopropionyl glycine and 14 with conventional forms of management, chosen on a random basis, was evaluated by means of radioactive colloidal gold clearance. Mean values were considerably reduced both before and after treatment, showing serious functional damage. A statistically significant increase in k constant and liver blood flow values was noted in the group treated with α-mercaptopropionyl glycine, though not in the control group. Clearance patterns are also discussed in the light of the blood chemistry data for liver function. (auth)

9225 CHEMICAL FORM OF PLUTONIUM IN URINE. Popplewell, D. S.; Stradling, G. N.; Ham, G. J. (National Radiological Protection Board, Harwell, Eng.). Radiat. Res.; 62: No. 3, 513-519(Jun 1975).

In vivo and in vitro experiments have shown plutonium to be bound to naturally occurring citrate in urine. This represents citrate-bound plutonium which has been ultrafiltered from the blood. (auth)

9226 THE EFFECT OF RADIOACTIVE RADON (^{222}Rn) LIBERATED FROM WATER ON THE BLOOD AND TISSUE

BLOOD FLOW DURING A RADIO-ACTIVE BATH. Halawa, B. (Akademia Medyczna, Wroclaw (Poland)). Pol. Tyg. Lek.; 28: 1638-1640(1973). (In Polish).

The blood and tissue blood flow of patients were investigated after a radioactive bath and inhaling radon collecting above the bath tube containing radioactive water. During the time of bathing the increase of blood and blood flow through tissues was in 68% due to inhaling of radon collecting above the water by respiratory ways. Twenty minutes inhalation above the bath tub with radioactive water causes similar increase of blood and tissue blood flow radioactivity as 15 minutes bathing in radioactive water. Such inhalations are better tolerated than bathing, especially by older people. (auth)

Animals

Refer also to abstracts 8906, 8922, 9201–9202, 9210, and 9214.

9227 (BNWL-1950(Pt.1)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1974 TO THE ERDA DIVISION OF BIOMEDICAL AND ENVIRONMENTAL RESEARCH. Part I. Biomedical Sciences. Thompson, R. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1975. Contract AT (45-1)-1830. 190p. Dep. NTIS $7.60.

Separate abstracts were prepared for 52 sections. (HLW)

For abstracts of individual sections see: 8472, 8905, 9054–9055, 9077–9078, 9090–9092, 9147–9148, 9194, 9201–9215, 9218, and 9228–9251.

9228 (BNWL-1950(Pt. 1), pp 17-18) DISTRIBUTION OF ^{241}Am AND ^{244}Cm IN DOGS AFTER INHALATION OF THE OXIDES. Craig, D. K.; Cannon, W. C.; Catt, D. L.; Herring, J. P.; Olson, R. J.; Powers, G. J.; Watson, C. R. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Dogs were exposed to $^{241}AmO_2$ or ^{244}CmO/sub x/ aerosols and sacrificed at various times postexposure. Both isotopes are readily translocated from the lungs to liver, skeleton and muscle, ^{244}Cm twice as rapidly as ^{241}Am. (auth)

9229 (BNWL-1950(Pt. 1), pp 21-22) EFFECTS OF PuO_2 PARTICLES DEPOSITED IN RAT LUNG FOLLOWING INTRAPERITONEAL INJECTION. Sanders, C. L. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

From 0.2 to 2.0 percent of intraperitoneally injected $^{239}PuO_2$ was found in the alveolar septa of rats at 1 to 2 years after injection, resulting in a cumulative radiation dose to the lung of up to 600 rads. Only one lung tumor was seen in 108 injected rats. It was concluded that sequestration and immobilization of large PuO_2 particles in the alveolar septa result in nil or low lung tumor incidence as compared to the high lung tumor incidence seen when PuO_2 is delivered to the lung as an aerosol. (auth)

9230 (BNWL-1950(Pt. 1), pp 24-27) TOXICOLOGY OF INHALED $^{238}PuO_2$ AND $^{239}PuO_2$ IN HAMSTERS. Sanders, C. L. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Male and female Syrian golden hamsters were exposed to $^{238}PuO_2$ or $^{239}PuO_2$ aerosols for study of plutonium metabolism and pathologic effects. Alveolar clearance decreased with increasing amounts of deposited plutonium. The metabolism of $^{238}PuO_2$ and that of $^{239}PuO_2$ were similar but gave evidence of a greater $^{239}PuO_2$ solubility. Adenomatous-squamous metaplasia was a common finding in the lung, particularly at the highest depositions. Only one primary lung tumor was seen in 172 necropsied hamsters up to a year after exposure. (auth)

9231 (BNWL-1950(Pt. 1), pp 28-30) TOXICOLOGY OF INHALED $^{239}PuO_2$ IN RATS. Progress Report. Sanders, C. L. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Environmental Research, Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Preliminary results are reported from an experiment still in progress. About 50 percent of the initial alveolar deposition of inhaled $^{239}PuO_2$ was cleared from the lung in the first 30 days; the remainder was retained with a biological half-life of about 200 days. The incidence of lung tumors may be increased following initial alveolar deposition of as little as 0.15 nCi. Squamous carcinomas in lung predominate at high deposition levels and adenocarcinomas at lower levels. (auth)

9232 (BNWL-1950(Pt. 1), pp 31-34) TOXICOLOGY OF INHALED $^{238}PuO_2$ IN RATS. Progress Report. Sanders, C. L. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Preliminary results are reported from an experiment still in progress. Alveolar clearance of $^{238}PuO_2$ was somewhat less than that for $^{239}PuO_2$, despite the greater in vivo solubility of $^{238}PuO_2$. The incidence of lung tumors may be increased following initial alveolar deposition of as little as 0.07 nCi. Squamous carcinoma in lungs predominated at high deposition levels and adenocarcinoma at lower levels. No hemangiosarcomas were seen with $^{238}PuO_2$. (auth)

9233 (BNWL-1950(Pt. 1), pp 35-37) TOXICOLOGY OF INHALED $^{244}CmO_2$ IN RATS. Progress Report. Sanders, C. L. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Preliminary results are reported from an experiment still in progress. About 50 percent of initial alveolar deposition of $^{244}CmO_2$ was cleared from the lung during the first day and about 90 percent by 30 days after exposure. $^{244}CmO_2$ is more readily absorbed from the lung than plutonium oxides, as evidenced by higher concentrations in bone and liver. Adenocarcinoma is the predominant tumor type thus far observed in the lung. Bone tumors were also observed. (auth)

9234 (BNWL-1950(Pt. 1), pp 40-42) DISPOSITION OF INHALED $Pu(NO_3)_4$ AND $Es(NO_3)_3$ IN RATS. Ballou, J. E. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Preliminary results indicate ^{253}Es is cleared from the lung more rapidly and translocated to liver and skeleton more extensively than either ^{238}Pu or ^{239}Pu. (auth)

9235 (BNWL-1950(Pt. 1), pp 49-51) PULMONARY CLEARANCE AND PATHOGENICITY OF INHALED HIGH-FIRED BERYLLIUM OXIDE. Cocarcinogenic Study With $^{239}PuO_2$. Sanders, C. L.; Cannon, W. C. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The alveolar retention half-life of beryllium oxide inhaled by rats was about 6 months. The alveolar clearance of $^{239}PuO_2$ was decreased to 60 percent of normal when PuO_2 was given at 1, 30, or 60 days after beryllium oxide. These results demonstrate the important role played by the alveolar macrophage in beryllium-induced granulomatous disease, and the rapid impairment of alveolar macrophage function by phagocytized beryllium oxide. (auth)

9236 (BNWL-1950(Pt. 1), pp 55-56) DEPOSITION OF INHALED POLYDISPERSED AEROSOLS IN BEAGLES AS A FUNCTION OF PARTICLE SIZE. Craig, D. K.; Buschbom, R. L.; Cannon, W. C.; Herring, J. P. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

A new technique is described for determining the percentage of aerosols deposited as a function of particle size in the lungs of beagle dogs during inhalation exposure. An example of the results is presented. (auth)

9237 (BNWL-1950(Pt. 1), pp 57-59) MINICOMPUTER PROCESSING FOR ON-LINE TIDAL VOLUME AEROSOL MEASUREMENTS. Mahan, R. E. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research, Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

A small computer installed in the Inhalation Toxicology Laboratory is used to monitor aerosol inhalation exposure of dogs. It is designed to provide data acquisition, processing, and reporting during an exposure to improve experimental exposure techniques. (auth)

9238 (BNWL-1950(Pt. 1), pp 60-62) ON-LINE MEASUREMENT OF PARTICLE SIZE DISTRIBUTION OF RADIOACTIVE AEROSOLS. Decker, J. R.; Mahan, R. E.; Craig, D. K.; Eklund, J. D. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

A device based on the varying impaction efficiencies of particles as a function of their aerodynamic equivalent diameters has been designed and built. It is being installed and calibrated in a dog exposure chamber where it will be used to determine in real time the particle size distribution of the aerosols being inhaled by the animals. (auth)

9239 (BNWL-1950(Pt. 1), pp 63) ADAPTATION OF A MAY SPINNING TOP MONODISPERSED AEROSOL GENERATOR TO ANIMAL INHALATION STUDIES. Cannon, W. C.; Craig, D. K. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Studies of respiratory deposition of aerosols in the beagle dog will be undertaken using monodispersed aerosols of ^{198}Au tagged iron oxide or metallic gold. In preparation for this study a dog exposure glove box was modified to accommodate a May spinning top aerosol generator. This generator is capable of generating monodispersed aerosols in the size range of 0.5 mu m to 5 mu m aerodynamic equivalent diameter, a range useful for such a study. Preliminary operation checks of the aerosol system have begun using uranine dye aerosols in place of the ^{198}Au tagged aerosols. A mass concentration 2.9 mg/m^3 of 2 mu m AED particles has been obtained. Such a concentration will be sufficient for tagged aerosols to be used in the study. (HLW)

9240 (BNWL-1950(Pt. 1), pp 64-65) DEVELOPMENT OF A BENZO(A)PYRENE DELIVERY SYSTEM FOR ANIMAL INHALATION STUDIES. Cannon, W. C.; Starkey, R. H. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Apparatus and techniques have been developed to expose experimental animals to aerosols of benzo(a)pyrene, a chemical carcinogen found in urban atmospheres and tobacco smoke. (auth)

9241 (BNWL-1950(Pt. 1), pp 79-81) INFLUENCE OF AGE ON THE DEVELOPMENT OF BONE TUMORS IN RATS INJECTED WITH ^{239}Pu CITRATE. Mahlum, D. D.; Sikov, M. R. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Rats of various ages, ranging from prenatal to young adult, were exposed to monomeric ^{239}Pu and bone tumor incidence established. The younger rats were less sensitive on an administered dose basis, but perhaps more sensitive on the basis of total cumulative radiation dose. The extremities were the preferential site of bone tumor development in the adults; tumors of the head predominated in the newborn and prenatal groups. (auth)

9242 (BNWL-1950(Pt. 1), pp 81-83) METABOLISM OF ^{241}Am CITRATE IN RATS RELATIVE TO AGE. Mahlum, D. D.; Sikov, M. R. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The biological disposition of ^{241}Am was studied in newborn, weanling, and adult rats. The initial deposition in liver was greater in the adults than in the newborns, and least in the weanlings. Skeletal deposition showed the inverse pattern. (auth)

9243 (BNWL-1950(Pt. 1), pp 83-84) TOXICITY AND DISTRIBUTION OF ^{241}Am AND ^{244}Cm IN THE RAT AFTER ADMINISTRATION AT NINE DAYS OF GESTATION. Sikov, M. R.; Mahlum, D. D. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Intravenous doses as high as 60 mu Ci/kg of ^{241}Am or ^{244}Cm to the pregnant rat at 9 days of gestation were neither embryocidal nor teratogenic. This lack of effect appears to be associated with a lower deposition of nuclide in the fetoplacental unit than has been found with other transuranic elements. (auth)

9244 (BNWL-1950(Pt. 1), pp 91-93) TISSUE DISTRIBUTION OF INJECTED PLUTONIUM IN IRON-DEFICIENT MICE. Ragan, H. A.; Free, M. J. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

When killed 6 days after injection, iron-deficient mice to whom ^{239}Pu citrate was administered intraperitoneally had body burdens approximately two-fold greater than did iron-replete mice. With the exception of the liver, all soft tissues, including testis, of the iron-deficient mice had a greater plutonium concentration than those of the control mice. (auth)

9245 (BNWL-1950(Pt. 1), pp 105-108) ABSORPTION OF URANIUM-233, NEPTUNIUM-237, PLUTONIUM-238, AMERICIUM-241, CURIUM-244, AND EINSTEINIUM-253 FROM THE GASTROINTESTINAL TRACT OF NEWBORN AND ADULT RATS. Sullivan, M. F.; Crosby, A. L. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Absorption of the nitrates of ^{233}U, ^{237}Np, ^{238}Pu, ^{241}Am, ^{244}Cm, and ^{253}Es by the adult rat was estimated at 0.03 percent, 1.0 percent, 0.006 percent, 0.012 percent, 0.04 percent, and 0.014 percent, respectively; absorption of the oxides of ^{241}Am and ^{244}Cm was estimated at 0.01 percent and 0.003 percent, respectively. These estimates are based on retention in skeleton and liver. Absorption of the nitrates of ^{237}Np, ^{238}Pu, ^{241}Am, ^{244}Cm, and ^{253}Es by the newborn rat was estimated at 6.6 percent, 2.9 percent, 5.0 percent, 2.0 percent, and 5.1 percent, respectively; absorption of the oxides of ^{241}Am and ^{244}Cm was estimated at 1.1 percent and 1.7 percent, respectively. The amount retained by the lower small intestine of newborn rats was frequently several times more than the amount absorbed, which could be a significant factor in evaluating the hazard potential of these radionuclides. (auth)

9246 (BNWL-1950(Pt. 1), pp 130) QUANTIFICATION OF INHALED PROMETHIUM. Nelson, I. C.; Ballou, J. E.; Shipler, D. B.; Craig, D. K. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

An experiment was performed this year in which a mixed promethium-samarium oxide aerosol was inhaled by beagle dogs. Preliminary results indicate that for a few weeks following exposure, promethium and samarium are sufficiently similar in their behavior to qualify samarium as a suitable carrier for promethium in beagle dogs. Plans will therefore proceed for the generation of suitable samarium-promethium aerosols for use in the exposure of human volunteers, with review of proposed experimental protocol by the Battelle-Northwest Human Subjects Committee, for the development of a diagnostic model for the excretion of inhaled promethium oxide. (auth)

9247 (BNWL-1950(Pt. 1), pp 137) OBSERVATIONS IN RATS 2 YEARS AFTER EXPOSURE TO Ca-DTPA AEROSOLS. Ballou, J. E.; Dagle, G. E. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Inhaled Ca-DTPA in 6 weekly 1-hr exposures, approximately 5 mg per exposure, did not affect weight gain or long-term survival of rats. One pulmonary adenocarcinoma was found in the group exposed to Ca-DTPA aerosols; however, this cannot be attributed to chelate treatment at this time. (auth)

9248 (BNWL-1950(Pt. 1), pp 138-140) TERATOLOGIC EFFECTIVENESS AND FETAL TOXICITY OF DTPA IN THE RAT. Sikov, M. R.; Smith, V. H.; Mahlum, D. D. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Ca-DTPA, injected intraperitoneally in rats from day 8 through 12 of gestation, was embryocidal in doses larger than 8-HD (eight times the human dose of 28.7 mu mol/kg body weight). The effect was 100 percent fatal at doses greater than 16-HD. No fetal deaths occurred from Zn-DTPA, even at 64-HD. Some fetuses from dams receiving greater than 8-HD of either salt showed an increase in hydronephrosis and some alteration in kidney structure. A few minor skeletal abnormalities were also observed at these doses. In general, the teratologic effects of DTPA, if any, were minor and sporadic. (auth)

9249 (BNWL-1950(Pt. 1), pp 140-141) TOXICITY OF INHALED Ca-DTPA IN THE DOG. Smith, V. H.; Lund, J. E.; Ragan, H. A.; Hackett, P. L.; Willard, D. H. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Anesthetized beagle dogs inhaled Ca-DTPA daily for 5 days through a tracheal catheter. No gross pathology specifically ascribable to the treatment was observed at necropsy 18 weeks later. Clinical chemistry, urinalysis, and bone marrow findings were essentially negative. While histopathologic and hematologic examination is still underway, gross observation and tests would indicate no toxic manifestations from aerosolized Ca-DTPA under the conditions of the experiment. (auth)

9250 (BNWL-1950(Pt. 1), pp 142) EFFECTS OF INGESTED, LOW LEVELS OF CHELATING AGENTS ON THE EXCRETION OF WELL-FIXED ^{238}Pu FROM THE RAT. Smith, V. H. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Ethylenediaminotetracetate (EDTA), diethylenetriaminepentacetate (DTPA), and oxytetracycline (OTC) were administered in the drinking water to rats intramuscularly injected 6 months previously with $^{238}Pu(NO_3)_4$. At dose levels roughly equivalent to those encountered by man in food, drink and medicament, EDTA, DTPA and OTC elicited no elevation in Pu excretion. The presence of these chelons would therefore not explain the occasional high urinary Pu output in untreated humans. (auth)

9251 (BNWL-1950(Pt. 1), pp 143) INAPPLICABILITY OF HIGH PRESSURE SPRAY INJECTION FOR CHELATE ADMINISTRATION. Smith, V. H. Mar 1975.

In Pacific Northwest Laboratory annual report for 1974 to the ERDA Division of Biomedical and Environmental Research. Part I. Biomedical Sciences. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

A high-pressure spray injector was tested for use in injecting chelating agents around radionuclides in wounds. It was difficult to employ because of the force required for proper injection, and it did not improve the effectiveness of the injected chelate in removing intramuscularly injected ^{238}Pu. (auth)

9252 (SZS-164, pp 10-18) CHANGES OF DEOXYRIBOSIDE CONCENTRATION IN URINE AND BLOOD PLASMA OF RATS AFTER INTERNAL CONTAMINATION WITH STRONTIUM-89. Solle, M.; Orban, U. Jul 1974. (In German).

In report of the National Centre for Radiation Protection of the GDR. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)).

The effects of single intravenous administration of ^{89}Sr (150 to 800 μCi/animal) on the concentration of total deoxyribosides in urine and blood plasma of rats are described. After administration of more than about 300 μCi/animal, deoxyriboside concentration in urine increased on the 1st and 2nd day, and then declined to subnormal values for a period of longer duration. In blood plasma, maximum values were between 12 and 24 h after administration and about 145% of normal values when 300 to 800 μCi were administered per animal. A decrease below normal values could not be observed. The results are compared with those obtained after external irradiation, and discussed with regard to the biochemical detection of radiation damages caused by internal contamination with radionuclides. (INIS)

9253 EFFECT OF SOME MUCOLYTICS ON THE ELIMINATION OF ^{131}I-HSA MACROAGGREGATE. Benko, G.; Kutas, V.; Kocsar, L.; Farkas, G. (Frederic Joliot-Curie Inst., Budapest). Izotoptechnika.; 18: No. 3, 121-125(Mar 1975). (In Hungarian).

Among the mucolytics, Mucosolvin, Tacholiquin, and Sicol, the first proved to be most effective in accelerating elimination and thus lowering radiation burden. (auth)

9254 UPTAKE OF A COLLOID IN RAT LIVER FOLLOWING INTRAVENOUS INTRASPLENIC AND INTRAMESENTERIC INJECTION. Karran, S. J.; Leach, K. G.; Wisbey, M. L.; Blumgart, L. H. (Welsh National School of Medicine, Cardiff). J. Nucl. Med.; 16: No. 5, 377-379(May 1975).

Intramesenteric and intrasplenic injections of /sup 99m/Tc-sulfur colloid in the rat resulted in significant differences between the mean uptakes in only some of the liver lobes. More important were the wider interlobular variations seen in the intrasplenic and intramesenteric routes of injection compared with the intravenous route. It is suggested that these differences result from laminar blood flow in the portal vein. In the light of our findings, previous evidence must be considered inconclusive. Laminar flow appears to vary between individual animals and may also vary from time to time in the same animal. Caution is therefore advised when other than systemic routes of injection are used. (auth)

9255 BIOLOGICAL HALF-LIFE AND DISTRIBUTION OF RADIOCESIUM IN A CONTAMINATED POPULATION OF GREEN TREEFROGS HYLA CINEREA. Dapson, R. W.; Kaplan, L. (Savannah River Ecology Lab., Aiken, SC). Oikos; 26: No. 1, 39-42(1975).

The radiocesium ^{134}Cs and ^{137}Cs content of adult male green treefrogs (Hyla cinerea) from a contaminated habitat at the Savannah River Plant was measured. There was significant negative correlation of body burden with body length and weight. Biological half-life of radiocesium in unfed, captive frogs held at 20° to 30°C averaged 30.1 d. (auth)

9256 RADIOCESIUM CONCENTRATIONS OF SNAKES FROM CONTAMINATED AND NON-CONTAMINATED HABITATS OF THE AEC SAVANNAH RIVER PLANT. Brisbin, I. L. Jr.; Staton, M. A.; Pinder, J. E. III; Geiger, R. A. (Savannah River Ecology Lab., Aiken, SC). Copeia; No. 2, 501-606(13 Jun 1974).

Concentration levels of ^{134}Cs and ^{137}Cs were determined for 117 snakes of 19 species collected on the AEC Savannah River Plant near Aiken, South Carolina. Snakes collected from the vicinity of a reactor effluent stream averaged 131.5 pCi radiocesium/g live weight, with a maximum of 1032.6 pCi/g, and represented the highest level of radiocesium concentration reported in the literature for any naturally-occurring wild population of vertebrate predators. These snakes had significantly higher concentrations of radiocesium than those collected in the vicinity of a reactor cooling reservoir which averaged 27.7 pCi/g live weight, with a maximum of 139.3 pCi/g. The radiocesium contents of snakes collected from uncontaminated habitats averaged 2.6 and 2.4 pCi/g live weight, respectively, and did not differ significantly from background radiation levels. Radiocesium concentrations approximated a log-normal frequency distribution, and no significant differences in frequency-distribution patterns could be demonstrated between collection areas. (auth)

9257 SOME ASPECTS OF RADIOCESIUM RETENTION IN NATURALLY CONTAMINATED CAPTIVE SNAKES. Staton, M. A.; Brisbin, I. L. Jr.; Geiger, R. A. (Savannah River Ecology Lab., Aiken, SC). Herpetolcgica; 30: No. 2, 204-211(Jun 1974).

Thirty-two captive snakes from contaminated natural habitats on or near the Savannah River Plant showed single-phase ^{137}Cs bioelimination curves suggesting that, in the wild state, they were near equilibrium with respect to this radionuclide at the time of capture. Radiocesium biological half-lives in the snakes averaged 131.3 ± 15.7 (SE) days with extreme values of 430.0 and 23.7 days. There was no correlation between radiocesium loss rate and initial body burden. Radiocesium loss rate showed a positive linear correlation with caloric intake and a negative exponential correlation with body weight. Less than 1 percent of radiocesium excretion could be accounted for in shed skins, the remainder being lost mainly through the feces. Two females which laid eggs in captivity transferred 6.37 and 6.43 percent of their total body burden to their eggs. Radiocesium showed a greater concentration in skeletal muscle than in kidney or liver, while fat bodies contained the lowest concentrations. Radiocesium concentrations of feces and stomach contents were generally low and were not correlated with total body burdens. (auth)

9258 BIOLOGICAL TEST ORGANISM IN MARINE RADIOECOLOGICAL INVESTIGATIONS. Bakunov, N. A. Sov. J. Ecol. (Engl. Transl.); 5: No. 1, 67-70(1974).

Translated from Ekologiya; 5: No. 1, 85-88(1974).

The accumulation of cesium-137 in some fish species of the Caspian sea was considered with reference to its accumulation in a test organism. This test organism was the herring Clupeonella engrauliformis, in which the accumulation of the radionuclide was investigated with sufficient reliability. The results obtained suggest that the use of a test organism as an indicator of the state of pollution of the environment and for evaluating radioecological situations is promising. (auth)

9259 PHYSICAL-CHEMICAL COMPOSITION OF YTTRIUM-91 IN BLOOD SERUM. Mikshevich, N. V. Tr. Inst. Ekol. Rast. Zhivotn.; No. 89, 25-28(1974). (In Russian).

The fate of the metal depends considerably on the concentration and the rate of administration of radioactive yttrium into the blood stream (the higher the concentration and the rate of administration, the lower is the level of metal-protein complexes) which may be explained by superimposition of the hydrolytic processes of yttrium ions at the blood pH on the complex formation. Sephadex and glass shift the equilibrium between various forms of yttrium and blood serum to some extent because of their competition for the metal ions. (JPRS)

9260 DYNAMICS OF THE ABSORPTION OF CESIUM-137 FROM THE GASTROINTESTINAL TRACT IN THE RAT IN RELA-

TION TO POTASSIUM CONCENTRATION. Malkina, R. M.; Malkin, P. M. Tr. Inst. Ekol. Rast. Zhivotn., Ural. Nauchn. Tsentr, Akad. Nauk SSSR; No. 89, 91-94(1974). (In Russian).

It has been demonstrated that the amount of K introduced into the digestive tract simultaneously with ^{137}Cs significantly alters the absorption dynamics of the latter. In other words, its decreased uptake in the presence of K may be used for binding significant quantities of the isotope to highly effective sorbents. (Ref. Zh.)

9261 RELATIONSHIP OF THE DIFFERENT PORTIONS OF THE RAT SKELETON AND THE DISTRIBUTION OF STRONTIUM-85 AND YTTRIUM-91. Lyubashevskii, N. M.; Men'shikova, G. A.; Utkina, V. F. Tr. Inst. Ekol. Rast. Zhivotn., Ural. Nauchn. Tsentr, Akad. Nauk SSSR; No. 89, 3-11(1974). (In Russian).

Weight ratios were determined for bones and the skeletal tissues (bones, cartilage, bone marrow) in rats. Investigations were conducted on the distribution of ^{85}Sr and ^{91}Y in the bones and skeletal tissues in comparison with the distribution of ^{45}Ca and ^{91}Y in the presence of an isotopic carrier, ^{137}Ce and ^{32}P. (Ref. Zh.)

9262 A STUDY ON THE CAPACITY OF SODIUM HEXAMETHAPHOSPHATE FOR A DECORPORATION OF RADIOACTIVE STRONTIUM. Bokova, N.; Nikolov, I.; Mikhajlov, M.; Kiradzhiev, G. (Nauchno-Izsledovatelski Inst. po Radiologiya i Radiatsionna Khigiena, Sofia (Bulgaria)). Khig. Zdraveopazvane; 17: No. 3, 239-243(1974). (In Bulgarian).

The influence of different doses, methods of administration, and the time of application of sodium hexamethaphosphate on the decorporation of radioactive strontium were studied. The highest percentage of decorporation was obtained when sodium hexamethaphosphate was applied in a dose of 1 g/kg of body weight, orally on the 10th minute and on the 24th hour after the incorporation of radioactive strontium. The combination of sodium hexamethaphosphate with some other decorporators, acting by a different mechanism, did not lead to an increase in the possibilities for an increased removal. (auth)

9263 AN ATTEMPT FOR ACCELERATED REMOVAL OF STRONTIUM-85 BY COMBINED APPLICATION OF DECORPORATING AGENTS. Nikolov, I.; Bokova, N.; Kiradzhiev, G.; Mikhajlov, M. (Nauchno-Izsledovatelski Inst. po Radiologiya i Radiatsionna Khigiena, Sofia (Bulgaria)). Khig. Zdraveopazvane; 17: No. 2, 137-142(1974). (In Bulgarian).

The possibilities for an accelerated removal of radioactive strontium were examined by combinated application of decorporating agents with different mechanism of action. Substances were used which accelerated the removal of the isotope by the inhibition of calcification, stimulation of decalcification, isotope dilution, or restriction of the resorption in the gastro-intestinal tract. The obtained results did not show any cumulation of the effects of different preparations in their combined application. The combinations in whose content stable strontium was included not only do not show decorporating properties, but created conditions for an increased accumulation of the isotope in the organism. (auth)

New Tracer Techniques

Refer also to abstracts 8950, 8952, 8966, and 9194.

9264 (IAEA-R-740-F) RESEARCH WITHIN THE COORDINATED PROGRAMME ON THE USE OF ISOTOPES AND RADIATION IN RICE PRODUCTION STUDIES. Final Report for the Period 15 December 1968–30 September 1974. Khin Win, U. (International Atomic Energy Agency, Vienna (Austria)). Aug 1974. 5p. INIS.

The water management experiment included two treatments, namely, continuous submergence of water and mid-term drainage at EPI. There was no significant differences in yield of grains between the water management treatments. Summary of results are represented as tables. Applications of nitrogen in two or more installments applied at transplanting and around EPI resulted in higher grain yields than that of single applications for fertilizer responsive variety like IR-5 grown on soil conditions like Cyogon, Burma. (INIS)

9265 (N-75-10694) APPLICATIONS OF THE DIRECT PHOTON ABSORPTION TECHNIQUE FOR MEASURING BONE MINERAL CONTENT IN VIVO. Determination of Body Composition in Vivo. Annual Progress Report, 15 July 1971–15 July 1972. Cameron, J. R. (Wisconsin Univ., Madison (USA). Bone Mineral Lab.). 1 Aug 1972. Contract AT(11-1)-1422. 157p. (NASA-CR-140708). NTIS $6.25.

The bone mineral content, BMC, determined by monoenergetic photon absorption technique, of 29 different locations on the long bones and vertebral columns of 24 skeletons was measured. Compressive tests were made on bone from these locations in which the maximum load and maximum stress were measured. Also the ultimate strain, modulus of elasticity and energy absorbed to failure were determined for compact bone from the femoral diaphysis and cancellous bone from the eighth through eleventh thoracic vertebrae. Correlations and predictive relationships between these parameters were examined to investigate the applicability of using the BMC at sites normally measured in vivo, i.e. radius and ulna in estimating the BMC and/or strength of the spine or femoral neck. It was found that the BMC at sites on the same bone were highly correlated and the BMC at sites on different bones were also highly interrelated. The BMC at various sites on the long bones could be estimated to between 10 and 15 per cent from the BMC of sites on the radius or ulna. (STAR)

9266 (ORO-2401-84) ERDA PROGRESS REPORT: RADIOISOTOPE STUDIES UTILIZING A LOW LEVEL WHOLE BODY COUNTER AND CLINICAL APPLICATIONS OF ACTIVATION ANALYSIS. Brill, A. B. (Vanderbilt Hospital, Nashville, Tenn. (USA)). 30 Apr 1975. Contract AT(40-1)-2401. 76p. Dep. NTIS $7.00.

The development of a whole-body scanning bed with computer control systems for use in scintiscanning seriously ill patients is reported. The computer controls the direction and motion of the bed and the patient can be scanned with a positional accuracy of 0.01 inch. A stationary gamma camera scintillation probe was developed for use for radionuclide function studies of the lungs, kidneys, and liver where the field of view of a conventional gamma camera is inadequate to cover all the pertinent regions of interest. Correlations between measured radiation dose distributions in patients during radionuclide scanning made using thermoluminescent dosimeters and computer calculations based on radionuclide decay data are discussed. Examples cited include the radiation dose distribution during lung scanning using ^{99}/sup m/Tc-labeled compounds, kidney scanning using ^{131}I-Hippuran, and hematopoietic system scanning using ^{59}Fe-labeled compounds. Diagnostic applications of activation analysis using measurements of deuterium using the (gamma, n) reaction are reported. A list is included of 18 publications during the period covered by this report. (CH)

9267 TECHNIQUE FOR PRODUCING CARDIAC RADIONUCLIDE MOTION IMAGES. Reese, I. C.; Mishkin, F. S. (Martin Luther King, Jr. General Hospital, Los Angeles). J. Nucl. Med.; 16: No. 5, 368-369(May 1975).

Sequential frames of different portions of the cardiac cycle are gated into a minicomputer by using an EKG signal recorded onto digital tape simultaneously with imaging information. Serial display of these frames on the computer oscilloscope or projection of 35-mm half frames of these images provides a cardiac motion image with information content adequate for qualitatively assessing cardiac motion. (auth)

9268 STUDY GUIDE IN NUCLEAR MEDICINE. A Modern, Up-To-Date Presentation. Fourth Nuclear Medicine Seminar, Miami, Florida, March 15–19, 1972. Ashkar, F.; Miale, A. Jr.; Smoak, W. (eds.). Springfield, IL; Charles C Thomas, Publisher (1975). 484p. (CONF-720358-). $22.75.

Thirty-eight lectures on nuclear medicine are included that present a general review for physicians planning to take the examination for the American Board of Nuclear Medicine. Basic science categories, radiation protection, radiation detection systems, radioisotope production, and the preparation of labeled compounds are covered, as well as diagnostic applications of radioisotope scanning. (CH)

9269 OPTIMUM PHOTON ENERGIES FOR THE MEASUREMENT OF BONE MINERAL AND FAT FRACTIONS. Watt, D. E. (Univ. of Dundee, Eng.). Br. J. Radiol.; 48: No. 568, 265-274 (Apr 1975).

Relative error functions have been calculated for the various single and double photon energy techniques used for the measurement of linear bone mineral and fat mass in vivo. By considering only those errors arising from statistical fluctuations in photon counting, useful information for guidance in the most efficient operation of the method was obtained. The results indicated that statistically the single energy method was always significantly better than the double energy method for measurement of both bone and fat fractions in soft tissue at total thicknesses up to 15 g/cm^2. In those circumstances where it may be necessary to use the double-photon energy technique there was an optimum sample thickness of 5 g/cm^2 for minimum error. Values of photon energy which permitted measurement with the maximum precision in the minimum count time were deduced for a wide range of practical conditions and are presented along with a table of potentially suitable radioisotopes. (auth)

9270 THIRD ANNUAL MEETING OF THE BRITISH NUCLEAR MEDICINE SOCIETY, LONDON, ENGLAND, MARCH

20–21, 1975. London; British Nuclear Medicine Society (1975). 72p. (CONF-750343-(Absts.)).

From 3rd annual meeting of the British Nuclear Medicine Society; London, UK (20 Mar 1975).

Abstracts are presented for the 63 papers that discuss recent advances in radioisotope scanning and new radiopharmaceuticals. (CH)

9271 CLINICAL DYNAMIC FUNCTION STUDIES WITH RADIONUCLIDES. Croll, M. N.; Brady, L. W.; Tatem, H. R. III; Honda, T. (eds.). New York; Meredith Corporation (1972). 315p.

The 17 chapters are divided into seven sections: fundamentals, renal, cardiovascular, cerebral, pulmonary, special topics, and summary. Separate abstracts were prepared for 14 chapters. (CH)

For abstracts of individual chapters see: 9272–9285.

9272 CLINICAL ASPECTS OF DYNAMIC RENAL IMAGING WITH RADIOCHLORMERODRIN, /sup 99m/Tc PERTECHNETATE, AND ^{131}I ORTHOIODOHIPPURATE. Freeman, L. M. (Yeshiva Univ., New York). pp 47–63 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

Three major radionuclide imaging studies are available for assistance in the diagnostic evaluation of renal disorders. Morphology and functional tubular mass may be depicted with mercury-197 chlormerodrin or one of the new technetium-99m renal imaging agents (iron ascorbate or chelate). Excretion data as well as visualization in severely diseased kidneys are obtained with iodine-131 ortho-iodohippurate (hippuran). Vascular patterns of the kidney and lesions within it are obtained using a small volume, high activity bolus of a short-lived radiopharmaceutical, such as technetium-99m pertechnetate. These procedures are to be considered complementary and not competitive with radiographic studies such as urography, nephrotomography, and selective renal angiography. Each clinical situation must be evaluated individually so that the optimal study or combination of studies is utilized to help supply whatever information is sought. Familiarity with the available imaging techniques and their limitations will help one approach such situations more intelligently. (auth)

9273 RADIOISOTOPIC ANGIOCARDIOGRAPHY: PRE- AND POSTOPERATIVE EVALUATION OF PATIENTS WITH CONGENITAL AND ACQUIRED CARDIOVASCULAR DISEASE. Kriss, J. P.; Enright, L. P.; Hayden, W. G.; Wexler, L.; Shumway, N. E. (Stanford Univ., Palo Alto, CA). pp 67–84 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

Results of intravenous radioisotopic angiocardiography demonstrate that markedly abnormal and distinguishable scintiphotographic patterns are obtained in a variety of specific cardiovascular diseases. The conditions include congenital and acquired heart disease, involving both right- and left-sided lesions, and diseases of the great vessels and pericardium. The scintiphotographic criteria which are being applied currently in our laboratory for diagnostic purposes in evaluating some of these conditions have been described, particular emphasis being given in this report to those patients who have been studied pre- and postoperatively. The accuracy and immediate clinical relevance of the data gained combined with simplicity, speed, and safety of the procedure make this an attractive, useful clinical procedure. In general, we recommend that radioisotopic angiocardiography be performed as a screening procedure prior to cardiac catheterization or selective contrast angiography. (auth)

9274 SEQUENTIAL DYNAMIC METHOD OF CARDIOVASCULAR SCANNING USING RADIOACTIVITY AND THE AUTOFLUOROSCOPE. Allen, H. C. Jr. (Baylor Univ., Houston, TX); Dizon, M. B.; McMullen, F. F. Jr. pp 85–97 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

The radioactive angiogram and radiocardiogram (using /sup 99m/Tc tracer) as performed with the digital autofluoroscope appear to be simple, atraumatic screening tests and aid in the diagnosis of certain acquired and congenital diseases of the heart. The cardiopulmonary transit time as well as normal intracardiac peak-to-peak transit times have been determined in normal and abnormal patients. Well-defined normal and abnormal radiocardiograms were obtained yielding valid information in the diagnosis of certain types of cardiovascular disease. (auth)

9275 SHORT-TERM PREDICTION OF MYOCARDIAL INFARCTION OR SUDDEN DEATH BY HEMODYNAMIC ASSESSMENT. Sevelius, G. G. (Peninsula Industrial Medical Clinic, Sunnyvale, CA). pp 99–122 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

Radiocardiograms using /sup 99m/Tc tracer proved to be a practical, reproducible, and highly accurate procedure for measuring cardiac output. The clinical assessment of cardiac output, using the cardiac index method, was found to be misleading and mathematically invalid. Clinical hemodynamic assessment can only be obtained by predicting cardiac output from a multiple regression formula which includes factors for age, pulse, and blood volume, and then computing the percent difference between the determined cardiac output and the predicted cardiac output. The percent difference is called hemodynamic assessment because it expresses the efficiency with which a heart pumps the body's circulating blood volume. Low hemodynamic assessments preceded myocardial infarctions or sudden death so often within six months after the determination that it was undeniably of predictive value. A low hemodynamic assessment suggested that a measurable, but presymptomatic heart failure with concomitant sluggish bloodstream is present and represents a high-risk state. These assessments also suggest that a therapeutic program, directed toward increasing stroke volume and decreasing circulating blood volume, might be the best regimen to prescribe for the patient at high risk in regard to myocardial infarction. (auth)

9276 INTERFERENCE OF SCALP AND SKULL WITH DYNAMIC ISOTOPE STUDIES OF BRAIN. Oldendorf, W. H. (Univ. of California, Los Angeles). pp 125–136 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

The overlying scalp and skull create artifacts in external brain counting measurements in which isotope appears in these tissues. It is much less of a problem in dynamic studies since high levels of superficial isotope are not found in the first few seconds after introduction into the blood by any anatomic route. Diffusible tracers concentrate somewhat less in the scalp and skull than in the brain immediately after injection by any route. Nondiffusible tracers of low molecular weight attain a much higher concentration in the scalp than the brain only after about the first minute because of passage from plasma to scalp extracellular fluid. This equilibration does not occur in brain because of the blood-brain barrier. Scalp and skull thus create much less of a problem with brief dynamic studies than with chronic long-term studies. Some physical considerations of external collimation are discussed, and means are suggested to minimize superficial isotope contributions to brain counts. (auth)

9277 INTRAVENOUS DYNAMIC NUCLEOGRAPHY OF THE BRAIN. Rosenthall, L. (McGill Univ., Montreal). pp 137–150 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

The advent of stationary imaging devices has created interest in studying cerebral blood flows and transits with diffusible and nondiffusible radioactive indicators. Much of this has disclosed interesting pathophysiology, but not necessarily of significant diagnostic import to include in routine patient workup. The conventional static brain scan is one of the more useful tests in the nuclear medicine armamentarium for uncovering and localizing intracranial disease. Unfortunately, it does not as a rule clearly distinguish cerebral vascular accidents, neoplasms, arteriovenous malformations, and so forth, which is important from the standpoint of patient management. Aside from clinical impressions a diagnosis is often based on the appearance of the radiocontrast angiogram, which is not always desirable because of the implicit hazards. Thus it is incumbent upon investigators to search for innocuous intravenous methods of identifying the various intracranial afflictions. Intravenous /sup 99m/Tc-pertechnetate comparisons of brain hemisphere perfusion as a routine complement to static brain imaging are useful. Estimations of disparate radioactive transits are made qualitatively from serial 4 to 5 sec exposure scintiphotographs. (auth)

9278 QUANTITATION OF CEREBRAL BLOOD FLOW WITH THE MULTIPLE-CRYSTAL CAMERA. Mongeau, B. (Hotel Dieu Hospital, Sherbrooke, Quebec). pp 151–165 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

A technique is described for the evaluation of the cerebral blood flow in vascular diseases of the brain. Results have been correlated with the clinical evaluation of the patients and/or confirmed by other conventional means. There is evidence that in many cases this technique has proven itself to be a useful tool in making the correct diagnosis. Because it uses the intravenous route, it is well-tolerated by the patients and can be performed on an outpatient basis. We believe this can become a screening procedure for detecting and evaluating cerebral vascular insufficiency. Finally we wish to emphasize the importance of performing a cervical flow study routinely at the same time as the hemispheric flow. (auth)

9279 CLINICAL VALUE OF A COMPUTER SYSTEM FOR DATA ACQUISITION, PROCESSING, AND DISPLAY OF CEREBRAL

DYNAMIC STUDIES. Smoak, W. M.; Smith, E. M.; Watson, D. D.; Nelson, J. P. (Univ. of Miami, FL). pp 167-175 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

Although the digital computer has had limited utility in nuclear medicine to date, it has proven of value as a source of information for future improvements. We have demonstrated that camera resolving time is currently not a significant problem for brain imaging. Investigations on the effect of rotation of the patient's head have emphasized the need for caution in isolated interpretation of numerical data. Camera nonuniformities may introduce dusturbing image artifacts. If nonuniformity of response were reduced to the level of 5 percent, then one could probably delete this function by the computer since the computer normalization programs developed to date are not entirely satisfactory. Current dynamic brain studies could be improved by increasing photon yield. Static images are not primarily photon limited, but differ from problems of camera nonuniformity. (auth)

9280 PRINCIPLES OF THE TRACER METHOD IN ASSESSING REGIONAL BLOOD FLOW. Potchen, E. J.; Siegel, B.; Meidinger, R. (Edward Mallinckrodt Inst. of Radiology, St. Louis). pp 177-189 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

The standard brain scan is abnormal when there is relative increase in blood volume or when there is an abnormal permeability to substances which normally cannot enter the brain tissue. The usual mechanism of abnormal permeability is based upon neovascularity in tissues which do not maintain the tight junctions one sees in the normal brain endothelium. These tight junctions prohibit the leakage of materials from the intra- to extravascular space, and when they are not available many materials can readily transit into the abnormal tissue substance and can therefore be discerned on a standard brain scan. In many instances, however, there is no gross breakdown in this blood-brain barrier, but more subtle derangement may be detected by determining changes in regional brain blood volume or the relative volume of distribution of various labeled materials. We have studied whether or not we can discern differences in brain spaces of two isotopes in experimental situations where the brain scan would be normal. For these models, we have used water-induced brain edema and triethyl-tin-induced brain edema in the experimental animal. These types of brain edema are standard techniques that neurochemists have used to investigate alterations of brain transport without gross destruction of brain tissue. In water intoxication, there is no difference in the microvascular anatomy or change in the /sup 99m/Tc pertechnetate space, but it is apparent from our studies that the brain swells at the expense of brain blood volume and by measuring brain blood volume against brain mass, i.e., transit of ^{131}I antipyrine versus ^{51}Cr labeled red cells, one can detect brain edema in a situation where the brain scan would be normal. It is these approaches with cameras and computers using dual energies that may afford a more simplified estimation of altered regional brain function than is now available with the internal carotid injection technique. Perhaps, when the equipment is available, these methods may have more widespread clinical utility because of their simplicity and lack of patient morbidity. (auth)

9281 COMPARISON OF RADIOAEROSOL WITH RADIOXENON INHALATION PROCEDURES IN OBSTRUCTIVE LUNG DISEASE AND PULMONARY EMBOLISM. Taplin, G. V. (Univ. of California, Los Angeles); Poe, N. D.; Isawa, T.; Dore, E. K. pp 193-208 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

The advantage of the ^{133}Xe single-breath inhalation and washout procedure is that it permits direct measurement of the distribution of ventilation both in patients with obstructive airway disease and in normal subjects. Probably the most important asset is that it allows one to measure (in quantitative manner if desired) airflow dynamics, i.e., the rates of gas entry and exit from various regions of the lung. Finally, repeated examinations may be made at frequent intervals because of the rapidity of gas exchange in the normal lung. A disadvantage of the xenon method is that only one projection or view of the lungs per examination can be made unless one desires to repeat the entire inhalation procedure with a second or third dose of radioxenon. Secondly, a camera is mandatory to generate lung images of xenon distribution at 20-second intervals or less. Thirdly, breath-holding is required of the patients for periods as long as 20 to 30 seconds. This requirement eliminates many of the sick patients who could most benefit from the procedure. Another serious disadvantage is that the 80 keV gamma energy of ^{133}Xe causes poor resolution of scan abnormalities and greatly decreases the sensitivity of the method to detect small lesions. The radioaerosol method is preferred in suspected pulmonary embolism for many reasons. The aerosol method requires minimal patient cooperation, diagnostic scan patterns are produced, breath-holding is not required, the site(s) of both partial and complete airway obstruction is visualized, multiple views of the chest may be obtained following a single inhalation period, relatively small lung lesions are detectable as a result of optimum resolution of the images with the higher energy test agents, and finally, the cost of the special equipment and radionuclides used is lower. (auth)

9282 STUDIES OF THE PULMONARY CIRCULATION WITH RADIOACTIVE MICROSPHERES. Wagner, H. N. Jr.; James, A. E. Jr. (Johns Hopkins Univ., Baltimore). pp 209-229 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

The use of /sup 99m/Tc-albumin microspheres to assess the pulmonary circulation has important clinical utility. Particle distribution of injected microspheres accurately reflects regional pulmonary distribution. The value of this diagnostic technique in patients with pulmonary edema, lung neoplasms, and congenital cardiac malformations is emphasized. (auth)

9283 DYNAMIC RADIONUCLIDE STUDIES IN PEDIATRIC NUCLEAR MEDICINE. Conway, J. J. (Northwestern Univ., Chicago). pp 233-251 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

The extension of nuclear medicine techniques into the pediatric field has been rather slow but a negative attitude toward the use of radionuclides in children has gradually receded with increased education, increased awareness of its value, and the ready availability of modern equipment and techniques. The increasing volume of work load has dictated that each study be done because of certain conditions or indications and not as a routine part of a workup for whatever cause. As a general rule the clinicians have used nuclear medicine as a consultation service. Examinations, therefore, are not done unless the indications in the way of a history or physical examination are readily known. Special techniques, such as radionuclide angiography, can be easily performed in infants or children. Sedation is useful when one plans to quantitate data from areas of interest which require patients to remain motionless for periods up to 30 minutes. When one is only interested in the image characteristics of a study, the rapidity of the technique requires little or no sedation. (auth)

9284 ASSESSMENT OF CEREBROSPINAL FLUID DYNAMICS WITH RADIONUCLIDES. Tatem, H. R. III (Doylestown Hospital, PA); Croll, M. N.; Brady, L. W. pp 277-283 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

Radionuclide cisternography has proven to be an excellent diagnostic tool in patients suspected of having normal pressure hydrocephalus. It is safe, relatively simple to perform, and can assist the physician in determining which patients would benefit from ventriculovenous shunting or other operative procedures. Six of nine patients with abnormal cisternograms but without ventricular filling improved following a shunting procedure. It was concluded that a shunting procedure is indicated in the absence of ventricular filling. (auth)

9285 INTRAVENOUS RADIOISOTOPE HEPATOANGIOGRAPHY. Hisada, K. I.; Tonami, N. (Kanazawa Univ., Japan). pp 285-295 of Clinical Dynamic Function Studies with Radionuclides. Croll, M. N. (ed.). New York; Meredith Corp. (1972).

Intravenous radioisotope hepatoangiography was performed using the scintillation camera and /sup 99m/Tc pertechnetate of /sup 113m/In Fe ascorbic acid. The normal liver is delineated at the portal phase of the hepatoangiogram with a simple intravenous injection of the radioactive bolus. Cases with hepatoma, multiple cysts, solitary cyst, hemangioma, and Banti's syndrome were demonstrated and clinical usefulness of radioisotope hepatoangiography discussed. The information offered by radioisotope hepatoangiography is related to the vascularity of the lesion. This technique can be of help in the differential diagnosis of hepatic masses and is suggested as a routine diagnostic tool because of its simplicity and safety. (auth)

9286 ARBEITSANLEITUNG FUER HAEMATOLOGISCHE UNTERSUCHUNGEN MIT RADIONUKLIDEN. (Guide for Hematological Investigations with Radionuclides). Pixberg, H. U. (Deutsche Klinik fuer Diagnostik, Wiesbaden (F. R. Germany)). Frankfurt am Main, F. R. Germany; Byk-Mallinckrodt Chemische Produkte (1973). 68p. (In German).

The book gives exact instructions on the carrying-out and evaluations of hematological examinations with radionuclides. The indications, normal values and possible interfering factors are given. The ^{57}Co-vitamin B_{12} excretion test (Schilling test), the determination of the blood volume with ^{51}Cr-labelled erythrocytes, the determination of the erythrocyte lifetime (with ^{51}Cr

and ^{59}Fe), the localization of the erythrocyte breakdown (with ^{51}Cr), the investigation of ferrokinetics (with ^{59}Fe) and the erythrokinetics (with ^{51}Cr and ^{59}Fe), case studies for ferrokinetics and erythrokinetics and the determination of the capacity of free iron bonding are individually described. (GE)

9287 DOSE-TIME EFFECTS OF COMPETITIVE DISPLACEMENT OF RADIOPERTECHNETATE BY SODIUM PERCHLORATE FOLLOWING ORAL AND INTRAVENOUS APPLICATION. Reinecke, V.; Plaszek, L.; Stroetges, M. W.; Schmitt, G. (Essen Univ. (Gesamthochschule) (F. R. Germany). Abt. fuer Nuklearmedizin). Nucl.-Med.; 13: No. 4, 360-370(Jan 1975). (In German).

The effect of various doses of sodium perchlorate in several dose fractions on the extent and the time scale of displacement of radiopertechnetate, in relation to the application mode, was studied. An intravenous dose of 50 mg perchlorate was in respect to competitive suppression of organs actively concentrating pertechnetate as effective as an intravenous dose of 1,000 mg ClO_4^-— simultaneously or 1,000 mg orally 30 min before the injection of radiopertechnetate. An intravenous injection of perchlorate given later also produces a complete and immediately beginning depletion of pertechnetate already accumulated in the thyroid, within a period of 195 min after $^{99m}TcO_4^-$ injection with a corresponding increase in blood levels. 20 mg result in incomplete depletion which becomes complete after a second additional dose. The intravenous application of perchlorate offers advantages in clinical use. (auth)

9288 RNA SYNTHESIS DURING MITOSIS. I. Correlation Between the Condensation of Chromosomes and the Incorporation of ^{3}H-Uridine. Frank, B.; Kiefer, G. (Freiburg Univ. (F. R. Germany). Pathologisches Inst.). Beitr. Pathol.; 152: No. 1, 1-18(1974). (In German).

Possible relationships between RNA synthesis and the degree of condensation during mitosis were studied. Asynchronous cultures of L-cells were incubated for 10 minutes with 1 $\mu C/ml$ ^{3}H-uridine and fixed. Following countings of silver grains after autoradiography the cells were stained according to the Feulgen procedure. Two different parameters were used as a measure for the 'degree of condensation' (mean optical density, reciprocal surface area occupied by the Feulgen stained material). The number of silver grains during mid-mitosis was roughly 10% of that of early prophase or early interphase. These changes in RNA synthesis occur within less than 15 minutes. During metaphase reciprocal area and mean optical density rise to values two to three times that of interphase and early prophase. The observed correlation between the compactness of chromosomes and their ability to prime RNA synthesis can be interpreted as a causal relationship. Depression of RNA synthesis may during mitosis merely be the result of chromosome condensation with no specific regulation mechanism involved. Under these aspects the mitotic chromosome is a model for the regulation of transcription processes by chromatin condensation. (GE)

9289 RENAL SCINTIGRAPHY WITH SUP(99m)Tc-PENICILLAMINE. Lichte, H.;Hoer, G. (Technische Univ. Muenchen (F. R. Germany). Nuklearmedizinische Klinik und Poliklinik). Fortschr. Geb. Roentgenstr. Nuklearmed.; 122: No. 2, 119-123 (Feb 1975). (In German).

By application of sup(99m)Tc-penicillamine in renal scintigraphy excellent scintigraphies of the kidneys, especially by using a gamma camera, can be obtained, even in case of damaged renal function, up to an increase of creatinine in serum of about 7 mg%. (auth)

9290 RADIOIMMUNOASSAY FOR OVINE AND CAPRINE GROWTH HORMONE: ITS APPLICATION TO THE MEASUREMENT OF BASAL CIRCULATING LEVELS OF GROWTH HORMONE IN THE GOAT. Hart, I. C.; Flux, D. S.; Andrews, P.; McNeilly, A. S. (National Inst. for Research in Dairying, Reading (UK)). Horm. Metab. Res.; 7: No. 1, 35-39(Jan 1975).

A specific double antibody radioimmunoassay for ovine and caprine growth hormone (GH) is described in which a comparison is made between the results obtained with purified preparations of ovine and caprine GH as the labelled antigens. Measurements of the circulating levels of GH in plasma taken from four lactating female, four castrated male and four virgin female goats showed no significant differences between the levels of GH in lactating and non-lactating animals. Marked variations in plasma GH were found between samples from different goats and between samples from the same goat. Possible reasons for these variations are discussed. (auth)

9291 THE DISTRIBUTION OF ^{3}H-PUTRESCINE AND ^{3}H-SPERMINE IN THE MEROISTIC OVARY OF MUSCA DOMESTICA: RELATIONSHIP TO METABOLISM OF NUCLEIC ACIDS. Fischer, H. A.; Erdmann, G.; Thiele, H. (Max-Planck-Institut fuer Hirnforschung, Frankfurt am Main (F. R. Germany). Arbeitsgruppe Neurochemie). Histochemie.; 40: No. 4, 361-369(1974). (In German).

Radioactively labelled putrescine, spermine, and uridine were injected intraabdominally into house flies (Musca domestica), and the distribution of radioactivity in the ovaries was autoradiographically determined after 1 and 3 hrs incorporation time. The oocytes were not labelled by ^{3}H-uridine or ^{3}H-spermine. In semithin sections Putrescine was found predominantly in the ooplasm, but not in the nucleus of the ovum. These results were compared with the results of similar experiments with grasshoppers panoistic ovaries. The differences, especially in the distribution of putrescine, are discussed in these two types of ovaries in relation to their different localization of nucleic acid synthesis. (auth)

9292 ^{3}H-THYMIDINE INCORPORATION AT THE END OF THE S PHASE IN CULTURED HUMAN LYMPHOCYTES. Berghoff, D.; Passarge, E. (Hamburg Univ. (F. R. Germany). Inst. fuer Humangenetik). Humangenetik.; 24: No. 2, 141-144 (1974).

Cultured human lymphocytes of female origin were exposed to 3 $\mu Ci/ml$ ^{3}H-thymidine for 2, 2¼, 2½, 2¾, and 3 hrs, repectively; a proportion of 0, 1.95, 6.4, and 16.7% of labelled metaphases were found among a total of over 3,000 metaphases examined. 25 metaphases with little overall radioactivity were analyzed in detail by grain count and grain distribution. Earlier studies confirmed that the grain distribution at the extreme end of the S phase is non-random in several regions of the chromosomal complement, but that a distinct interval ('Z interval') probably does not exist. (auth)

9293 RADIO-ASSAY OF SERUM FOLATE. Dunn, R. T.; Foster, L. B. (Patterson Coleman Labs., Tampa, FL). Clin. Chem.; 19: No. 10, 1101-1105(1973).

The serum is heated on a boiling-water bath with lysine buffer soln. of pH 10.5 to destroy the binding capacity of endogenous protein, then the mixture is diluted with [^{3}H] folate, beta-lactoglobulin soln. is added, and, after 45 min., the free and bound forms of folate are separated by centrifugation with hemoglobin-coated charcoal; the supernatant soln. is analyzed for ^{3}H by a liquid scintillation technique. The method is rapid and simple. (Anal. Abstr.)

9294 COMPETITIVE RADIO-LIGAND ASSAY FOR DANAZOL [17 BETA-HYDROXYPREGN-4-EN-20-YNO(2,3-d)ISOXAZOLE] BY USING PREGNANT-GUINEA-PIG SERUM. Creange, J. E.; Potts, G. O. (Sterling-Winthrop Research Inst., Rensselaer, NY). Steroids; 23: No. 3, 411-420(1974).

Human plasma (50 mu l) is mixed with H_2O (0.5 ml), and the mixture is extracted with hexane (3 x 3 ml) and the dried extract is submitted to chromatography to separate the antifertility drug danazol from progesterone and other interfering compounds (including metabolites of danazol). The drug zones are extracted with ethanol, and the soln. so obtained is analyzed for danazol by a binding method involving use of [^{3}H] progesterone-saturated protein from guinea-pig plasma. The bound and free steroids are separated with use of charcoal, and the supernatant soln. is counted for ^{3}H. Recovery is approximately equal to 58 percent, and the calibration graph is rectilinear for up to 12 ng of danazol. Attention is drawn to the fact that the binding system used has hitherto been considered virtually specific for progesterone. (Anal. Abstr.)

9295 RADIOMETRIC ASSAY OF CITRATE-CONDENSING ENZYME [CITRATE(SI)-SYNTHASE] IN LIVER TISSUE AND MITOCHONDRIA. Dixit, P. K.; Raul, C. (Univ. of Minnesota, MN). Clin. Chem.; 19: No. 10, 1106-1111(1973).

The method involves measurement of ^{14}C-labelled citric acid formed from labelled acetyl-CoA by the enzyme-catalysed reaction with oxaloacetic acid. The citric acid is treated with KBr, $KMnO_4$ and Br to form pentabromoacetone and $^{14}CO_2$, and the $^{14}CO_2$ is absorbed in Hyamine 10-X hydroxide soln. for liquid scintillation counting. The method has been applied to rat muscle and liver homogenates and to liver mitochondria. For standards containing 138 to 500 mu g of the enzyme per litre, results agreed well with those of the colorimetric method. Activities down to 0.1 nmole per min. could be measured reproducibly and without interference from acetate or pyruvate. (Anal. Abstr.)

9296 CORRELATION BETWEEN SKELETAL CALCIUM MASS AND MUSCLE MASS IN MAN. Ellis, K. J.; Cohn, S. H. (Brookhaven National Lab., Upton, NY). J. Appl. Physiol.; 38: No. 3, 455-460(Mar 1975).

Measurements of total body potassium (TBK) and calcium (TBCa) were made on 317 subjects by the techniques of whole-

body counting and total-body neutron activation analysis (TBNAA), respectively. The TBK/TBCa ratios were constant for normals over the age range studied. The males had more cellular mass (TBK) per unit skeletal mass (TBCa) than the females, as indicated by their respective TBK/TBCa ratios. In general, patients with various metabolic disorders tended to follow the physiological trend found in the normals. In a number of metabolic disorders, the loss of TBK was usually approximately 60 percent of that of the TBCa when expressed in terms of the predicted normal values. This suggests that the mechanism causing the loss of calcium in physiological and altered metabolic states simultaneously involves both the skeleton and its associated musculature. (auth)

9297 PRODUCT STANDARDS FORM FOR NEW RADIOPHARMACEUTICALS. Warbick, A. (Princess Margaret Hospital, Toronto). Am. J. Hosp. Pharm.; 31: 165-166(Feb 1974).

The United States Pharmacopeia and the British Pharmacopoeia have not yet established standards for new radiopharmaceuticals on the market or in the literature. The radiopharmacist must therefore find some way to cope with the problem of establishing standards for radiopharmaceuticals which he may develop himself. Standards and limitations for each new radiopharmaceutical should be established in a responsible and orderly manner. In the standards, a review should be made of the pharmaceutical, radioactive, chemical, and pharmacological properties of the product. In addition, standards and methods of determining labelling efficiency, sterility, and apyrogenicity must be devised and maintained. An outline is presented to serve as a guideline for the radiopharmacist in setting up a new product standards form when developing a new radiopharmaceutical. (auth)

9298 TUMOROPHILIC ^{67}Ga SCANNING: A RETROSPECTIVE STUDY. Kight, J. L.; Van Hove, E. (Nuclear Radiology, Methodist Hospital of Indiana, Inc., Indianapolis). J. Indiana State Med. Assoc.; 67: 803-806(1974).

Fifty patients referred for the staging of Hodgkin's disease have been studied in retrospect. Serial anterior and posterior ^{67}Ga whole-body scans were done. Gallium was found to localize not only in malignant tumors but in benign lesions and infectious processes as well. Gallium-67, therefore, is not the ultimate radionuclide for tumorophilic scanning, since it is not entirely tumor-specific. However, the results, when correlated with the clinical and pathological findings, were encouraging. Gallium scanning is now becoming a part of the routine work-up for such entities as lymphoma, bronchogenic carcinoma, and other high grade malignancies. Further study of patients with bronchogenic carcinoma to determine operability prior to surgery is now being evaluated. (auth)

9299 USE OF RADIOPERTECHNETATE IN THE DIAGNOSIS OF MECKEL'S DIVERTICULUM. Henry, J. N.; Rosenthall, L.; Murphy, D. A. (Montreal Children's Hospital). J. Tenn. Med. Assoc.; 65: No. 10, 895-897(Oct 1972).

Pertechnetate labeled with ^{99}/sup m/Tc is actively concentrated by gastric mucosa. This feature was applied to the detection of ectopic gastric mucosa in Meckel's diverticula in children using external imaging. Twelve diverticula were encountered in 47 children and 10 were shown to be lined with gastric mucosa on histological examination. Six of these yielded a visible concentration of radiopertechnetate preoperatively. (auth)

9300 EFFECTS OF DEXAMETHASONE ON DISTRIBUTIONS OF WATER AND PERTECHNETATE IN BRAINS OF CATS AFTER MIDDLE CEREBRAL ARTERY OCCLUSION. Hoppe, W. E.; Waltz, A. G.; Jordan, M. M.; Chem, B.; Jacobson, R. L. (Univ. of Minnesota, Minneapolis). Stroke; 5: No. 5, 617-622(1974).

Large parenteral doses of dexamethasone were given to five of ten cats after transorbital occlusion of one middle cerebral artery and to two of four cats after sham operations. Two days later the water content and brain/blood ratios of pertechnetate were measured in samples of cerebral tissue that were categorized as non-ischemic, ischemic, or infarcted. Values for infarcted tissue were greater than those for ischemic tissue in untreated cats, but not in cats that received dexamethasone. The drug had no apparent effect in ischemic tissue that was not necrotic. These results help explain inconsistencies in previous studies and help define the potential usefulness of dexamethasone for treatment of cerebrovascular disease. (auth)

9301 REGIONAL CEREBRAL BLOOD FLOW IN MAN DETERMINED BY THE INITIAL SLOPE OF THE CLEARANCE OF INTRA-ARTERIALLY INJECTED ^{133}Xe. Olesen, J.; Paulson, O. B.; Lassen, N. A. (Bispebjerg Hospital, Copenhagen). Stroke; 2: 519-540(1971).

The regional cerebral blood flow can be calculated from the initial slope of the logarithmically displayed clearance curve following intra-arterial injection of ^{133}Xe. The relationship between this parameter and the values resulting from stochastic (height over area) and compartmental analyses is extensively discussed. (CH)

9302 INDICATIONS FOR LIVER SCINTIGRAPHY. Lopez-Majano, V. (Jackson Park Hospital, Chicago). Int. Surg.; 59: No. 6-7, 362-366(1974).

Hepatic scintigraphy is a simple method to visualize the liver. It requires simply the administration of a substance primarily metabolized by the liver, such as colloids. Materials are trapped by the Kupfer cells, and if the colloid is labeled with a radionuclide of energy adequate for external detection of radiation, a visual image relating to the distribution of the radioactive colloid in the liver will be created. The most useful colloid for this purpose is sulfur colloid, and the radionuclide usually employed to label it is ^{99}/sup m/Tc. The characteristics of various radionuclides and agents which can be used for liver scintigraphy are reviewed. (CH)

9303 IMPROVED METHOD FOR LIQUID SCINTILLATION COUNTING OF ^{59}Fe IN FERROKINETIC STUDIES. Perugini, S.; Barosi, G.; Cazzola, M. (Univ., Pavia, Italy). Haematologica (Pavia); 59: No. 1, 54-67(Mar 1974).

An improved method for liquid scintillation counting of ^{59}Fe in plasma and whole blood is described. About 2 ml of venous heparinized blood are required for the assay of the radioiron in plasma and erythrocytes. Solune-100 as a solubilizer and Instagel as a scintillation solution are used in sample preparation. In ferrokinetic studies this method has three advantages over the conventional method for ^{59}Fe gamma counting: it allows a reduction in the total blood withdrawal from 120 to 150 to about 40 ml and in the total counting time from 4.5 to about 2 days, with a four- or fivefold increase in counting efficiency. The high counting efficiency and the low background allow to have a better counting statistics, particularly for the low activity plasma samples from the 2nd to the 14th day of study. Both in normal volunteers and in anemic patients this method has revealed transient elevations in plasma radioactivity, which cannot easily be detected by conventional gamma counting of ^{59}Fe. (auth)

9304 PLACE OF MYOCARDIAL SCINTIGRAPHY IN THE DIAGNOSIS OF CORONARY HEART DISEASE. Heeger, H. Wien. Klin. Wochenschr.; 86: No. 18, 539-543(4 Oct 1974). (In German).

The existing correlations between ECG and myocardial scintigraphy are demonstrated on the basis of 65 cases with coronary heart disease verified by coronary angiography and myocardial scintigraphy. There is close correlation between the ECG and the scintigraphic findings in patients with a transmural myocardial infarct, whereby the defect in the scintigrams usually corresponds to akinetic zones in the ventriculogram. Myocardial scintigraphy is definitely superior to ECG as long as myocardial infarction has not taken place. In the stage of chronic angina pectoris the fixation deficits in the myocardial scintigrams are diagnostic of the permanent lesions caused by a reduction in myocardial blood flow owing to coronary artery stenosis. By contrast, a normal resting ECG is found in nearly 40% of cases, in spite of myocardial circulation defects. Since myocardial scintigraphy thereby permits determination of the degree of postnecrotic fibrosis of the heart muscle, this method of investigation is of special value in assessing the indications for coronary surgery in each individual case. (auth)

9305 ELECTRON MICROSCOPIC STUDIES ON MINERAL MOVEMENT DURING CALCIFYING PROCESS OF HARD TISSUES. I. ^{45}Ca Uptake of Ameloblasts During Enamel Matrix Formation. Nobumitsu, O.; Tohru, S. (Kanazawa Univ. Hospital, Japan). Shika Kiso Igakukai Zasshi; 14: No. 4, 560-570(Dec 1972).

The role of ameloblasts to minerals (mainly Ca) during enamel matrix formation was studied by electron microscopic autoradiography using ^{45}Ca as a tracer. Four rats were administered 10 μc/g of ^{45}Ca intraperitoneally, and the sample tooth germs of the incisors and molars were excised from rats killed at 15, 30 minutes, 1, and 2 hours after administration. Autoradiogram revealed intracellular localization of many silver grains of ^{45}Ca in rough endoplasmic reticulums, Golgi field, nuclei, and small vesicles other than in mitochondrias which showed great localizations of silver grains. Calcium-45 taken up in the ameloblasts mainly entered mitochondrias during 15 minutes to 2 hours period of administration, and gradually transmitted to the regions of the Tomes's process. It was considered that ^{45}Ca transmitted through cell to cell, not through intercellular spaces. (JA)

9306 ^{85}Sr IN THE DIAGNOSIS OF SKELETAL DISEASE. Firusian, N. (Univ., Essen). Dtsch. Med. Wochenschr.; 99: 1648-1653(16 Aug 1974). (In German).

Strontium-85, in a dose of 0.2 mCi, was administered to ten persons without skeletal disease (group I), seven with metastatic

destruction of vertebrae by solid tumors and two with malignant systemic disease (group II), and five after circumscribed radiotherapy of vertebral metastases (group III). External measurement gave an average effective half-life of 7.8 days in group I, 23.9 days in group II, and in group III a result similar to that in group I. Animal experiments have shown that the effective half-life is normal in fresh and old fractures. Measurements of the effective half-life of ^{85}Sr by external measurement, taken in conjunction with skeletal isotope scanning, can be used in the differential diagnosis of circumscribed skeletal disease. (auth)

9307 PREPARATION AND PROPERTIES OF AN ANTISERUM FOR THE RADIOIMMUNOASSAY OF SERUM CONJUGATED CHOLIC ACID. Murphy, G. M.; Edkins, S. M.; Williams, J. W.; Catty, D. (Univ. of Birmingham, Eng.). Clin. Chim. Acta; 54: 81-89 (1974).

A radioimmunoassay for the measurement of serum conjugated cholic acid has been developed. Antiserum to glycocholic acid coupled to bovine serum albumin was raised in rabbits. The antiserum was labelled with glyco[^{3}H] cholic acid and the bound label was separated from the free by precipitation using saturated ammonium sulphate. The amount of label bound decreased linearly with logarithmic increase in the amount of (non-active) glycocholic acid present (10 to 60 pmol). The cross reactivity of the common bile acids at 50% displacement of bound label was: taurocholic 100%; conjugated chenodeoxycholic acid 10%; conjugated deoxycholic 5%; cholic 10%; chenodeoxycholic and deoxycholic 2.5%. No cross-reactivity was detected with lithocholic acid or its conjugates, or with cholesterol. Between batch precision of the lowest standard concentration (0.1 μmol/l) was 14% and of the highest standard concentration (0.6 μmol/l) < 10%. It was not possible to obtain consistent data on unextracted sera and a simple one stage extraction procedure with ethanol was used. Fasting serum conjugated cholic acid concentrations in eight laboratory personnel were 0.55 to 1.8 μmol/l. This method is a rapid and sensitive means for providing an indication of serum conjugated cholic acid concentrations but because of the cross reactivity properties of the antisera, it is not specific for conjugated cholic acid. (auth)

9308 RAPID RADIOIMMUNOASSAY FOR THE EVALUATION OF THYROXINE IN UNEXTRACTED SERUM. Herrmann, J.; Rusche, H. J.; Krueskemper, H. L. (Univ., Dusseldorf). Clin. Chim. Acta; 54: 69-79(1974).

A rapid, specific, precise, and sensitive radioimmunoassay (RIA) for measurements of thyroxine (T_4) in unextracted serum is presented. The assay is characterized by the use of specific thyroxine binding rabbit antiserum in a final dilution of 1:2000 and 8-anilinonaphthalene 1-sulphonic acid (ANS, 600 μg per test-tube) for the displacement of T_4 from its binding with thyroxine binding globulin. The method described has several advantages over conventional displacement techniques. The setting up of the assay is half automatic, the working time is short (about 4 h for 100 samples), only 25 μl of serum are needed for one sample, the displacement of thyroxine from serum protein by ANS is almost complete (98%), the sensitivity of the assay (0.24 μg T_4/dl) is far greater than that of displacement methods and the standard curve is linear from 0.24 to 60 μg T_4/dl, thereby allowing accurate measurements over a wide range in one attempt. The overall agreement between the results obtained using the RIA and a displacement technique in 189 sera of different thyroxine concentrations was good (r = 0.9407). In sera of hyperthyroid patients, however, the average T_4 estimate by radioimmunoassay exceeded those obtained using the displacement method. In recovery experiments with four methods for the evaluation of T_4, good agreement between expected and measured values, even in the high concentration range, was seen with the radioimmunoassay as well as with the PBI determination, whereas poor agreement was found with two displacement techniques. The reason for this was found in the levelling off of the standard curves of the conventionally processed displacement methods when the thyroxine concentration exceeds 17 μg/dl. Good recovery of added thyroxine even in the high concentration range was achieved when the procedure of the displacement method was appropriately adjusted. Therefore, the discrepancies observed between the results when obtained from radioimmunoassay or displacement techniques seem to depend on the methodological problems of a nonadjusted displacement method. (auth)

9309 DETECTION OF PENICILLIN ALLERGY OF THE IMMEDIATE TYPE BY RADIOIMMUNOASSAY OF REAGINS (IgE) TO PENICILLOYL CONJUGATES. Wide, L.; Juhlin, L. (University Hospital, Uppsala). Clin. Allergy; 1: 171-177(Jun 1971).

Reaginic antibodies (IgE) to penicilloyl were detected by an in vitro method, a radioimmunological technique (RAST), in the sera of nine patients out of eleven with a recent history of penicillin hypersensitivity of the immediate type. Provocation tests in two patients with negative RAST were negative as well as in twelve patients having had a possible penicillin hypersensitivity reaction 7 months to 14 years ago. Results from skin tests and RAST agreed. Skin tests and RAST reactions were negative for thirty-two patients with a history of penicillin reactions of the delayed type. The results of this study indicate that the RAST is a valuable alternative to the more dangerous intracutaneous test with penicilloyl-polylysine for detection of penicillin hypersensitivity of the immediate type. (auth)

9310 RENIN ACTIVITY BY RADIOIMMUNOASSAY: THE PLASMA INCUBATION STEP. Osmond, D. H.; McFadzean, P. A.; Scaiff, K. D. (Univ. of Toronto). Clin. Biochem.; 7: 52-63(May 1974).

Plasma incubation protocols by which angiotensin I can be generated for radioimmunoassay, including those employed by three leading commercial renin activity kits, were investigated. Without buffering, (kits No. 1 and 2), the pH of human and rat plasma rises to 8, or above, within 1 hour of incubation at 37°C, even if initially adjusted to 6 as recommended by some workers. Commonly, angiotensin generation rate declines within 1 to 2 hours, invalidating standard 3 hour incubations. Plasma diluted with as little as 1 volume of various buffers generates significantly less angiotensin than more concentrated plasma (0.1 volume dilution). Dilution with 2 volumes of maleate buffer, pH 6, final molarity 0.133 (kit No. 3) controls pH satisfactorily, but yields suboptimal amounts of angiotensin. Phosphate buffer, 0.1 or 1.0 volume, 0.05 to 0.15 M in the incubate, pH 6, provides pH control and generally higher angiotensin generation than in the presence of comparable molarities and dilutions of phosphate or Tris buffers adjusted to pH 7.4. Successful buffering does not guarantee linear angiotensin production within a predetermined incubation period. We propose the use of sequential incubation intervals, as short as 15 minutes, in order to establish a region of linearity from which more accurate estimates of plasma renin activity can be made in humans and rats. (auth)

9311 DIAGNOSTIC INTEREST OF pH MEASUREMENTS AND RADIOISOTOPE SCAN IN A CASE OF PAROTID DUCT INFLAMMATION. Laudenbach, P. (Clinique de Stomatologie et de Chirurgie Maxillo-Faciale de la Salpetriere, Paris); Ancri, D.; Szabo, G. Rev. Stomatol.; 74: No. 7, 543-546(1973). (In French).

Inflammation in the parotid duct was detected by measurement of salivary pH and by scintiscanning. These investigations will therefore become useful in diseases of the salivary glands. (auth)

9312 CHANGES IN SUBCUTANEOUS AND MUSCLE BLOOD FLOW AFTER SHORT-WAVE DIATHERMY. Hovind, H.; Nielsen, S. L. (Univ. of Copenhagen). Bibl. Anat.; No. 11, 417-422(1973).

Local heating with short-wave diathermy gives an increase in temperature related to the applied dose. This is associated with an increase in subcutaneous blood flow. At low doses, a late hyperemia in skeletal muscle was found. The maximum tolerable doses causes an immediate increase in flow when the deep temperature overrides a critical level of 42°C. The percentage changes in blood flow in skeletal muscle after diathermy is, however, much smaller than can be seen after active muscle work. (auth)

9313 DIAGNOSTIC VALUE OF A RADIOIMMUNOASSAY FOR PARATHYROID HORMONE IN HUMAN SERUM. Almqvist, S.; Hjern, B.; Waesthed, B. (Karolinska Sjukhuset, Stockholm). Acta Endocrinol.; 78: 493-509(1975).

A radioimmunoassay for the measurement of immunoreactive parathyroid hormone (PTH) in human serum is described. The assay is based on the ability of human parathyroid hormone (h-PTH) to compete with ^{125}I-labelled bovine parathroid hormone (b-PTH) for binding to a guinea-pig antiserum directed against b-PTH. The linear part of the standard curve was parallel with dose response curves for anti-b-PTH serum reacting with dilutions of sera from patients with primary hyperparathyroidism and from h-PTH purified from human parathyroid adenomas, indicating that levels of immunoreactive PTH could be expressed as b-PTH equivalents. The range in 62 healthy blood donors was 1.1 to 2.5 ng b-PTH Eq./ml. The reproducibility was satisfactory, and the sensitivity permitted the measurement of PTH concentrations down to 0.8 ng b-PTH Eq./ml. No cross-reaction with h-CT, h-STH, or h-ACTH was observed. The clinical value of the assay has been considered in a number of patients with various disorders of calcium metabolism, diagnosed and treated conventionally. Patients with primary hyperparathyroidism and increased S-creatinine had higher PTH levels than those with normal S-creatinine. After parathyroidectomy, all previously increased PTH levels became normal or low. However, in normocalcaemic patients there were also some falsely elevated PTH values which

limit the diagnostic value of the assay in this group of patients. Low PTH values were observed in patients with hypercalcaemia due to malignant disorders, indicating that PTH determination may be of some value in the diagnosis of patients with hypercalcaemia of unknown origin. (auth)

9314 ALLERGENS IN TIMOTHY POLLEN IDENTIFIED BY CROSSED-RADIO-IMMUNO-ELECTROPHORESIS (CRIE). Weeke, B.; Loewenstein, H.; Nielsen, L. (Rigshospitalet, Copenhagen). Acta Allergol.; 29: 402-417(1974).

A timothy pollen (Phleum pratense) extract has been shown by examination with crossed immunoelectrophoresis to contain 28 antigens. Amongst these antigens are allergens which are capable of stimulating the production of IgE in man, and of reacting specifically with timothy specific IgE in patients with hay fever. From a clinical point of view, the extracts used in the diagnosis of allergy and immunotherapy should contain the allergens in as pure a form as possible. All other antigens present may, due to antigenic competition, interfere with the precision of the diagnosis and with the immune response during immunotherapy. By means of crossed-radio-immuno-electrophoresis (CRIE) it is possible to identify those timothy antigens which are able to bind timothy specific IgE from hay fever patients' sera. Following identification, the allergens may be characterized and quantified by CIE. The CRIE has to be carried out before characterization and purification of the allergens in the extracts can be performed. In this communication we report an examination by CRIE of a number of timothy allergic patient sera, and compare the results with those obtained using other procedures for the diagnosis of allergy. (auth)

9315 RENAL METASTASES SIMULATING KAPOSI SARCOMA. Rogow, L.; Rotman, M.; Roussis, K. (New York Medical Coll.). Arch. Dermatol.; 111: No. 6, 717-719(Jun 1975).

A case of renal cutaneous metastases simulated Kaposi sarcoma and the condition was misdiagnosed as Kaposi sarcoma. A new technique was employed using the isotope technetium-99m as the compound sodium pertechnetate Tc-99m for the diagnosis and evaluation of the extent of Kaposi sarcoma. The failure to demonstrate a positive isotope scan in our case was a clue to the incorrect diagnosis of Kaposi sarcoma. (auth)

9316 BLOOD FLOW MEASUREMENTS IN SKIN FLAPS. Nathanson, S. E.; Jackson, R. T. (Emory Univ. School of Medicine, Atlanta). Arch. Otolaryngol.; 101: No. 6, 354-357(Jun 1975).

For the last 50 years, the empirical approach of set length to width ratios for skin flaps has been held valid. Not until Milton's work in 1971 was this concept challenged. This report presents a method where precise, reproducible, and quantitative measurements of skin blood flow can be made using four radioactive nuclide microspheres and measures the blood flow changes in flaps of differing length to width ratios. Conclusions from our data suggest that the cutaneous blood flow in ventrally based, abdominal skin flaps in dogs is independent of base width as measured immediately after outlining and elevation. (auth)

9317 CORONARY ARTERY PERFUSION SCANNING WITH ^{131}I-MAA INJECTED DIRECTLY INTO THE CORONARY ARTERY OF CONGENITAL CORONARY ANOMALIES. Endo, M.; Miyata, K.; Kitamura, N.; Yamazaki, T.; Takao, A.; Konno, S. (Heart Inst. of Japan, Tokyo). Jap. Heart J.; 15: No. 1, 28-36(Jan 1974).

5 μCi/Kg ^{131}I-MAA was injected into the right coronary arteries in Cases 1, 2, and 3 under the diagnosis of right coronary artery fistula, and in Case 4 under the diagnosis of Bland-White-Garland syndrome. The results were compared with the angiocardiogram and right heart catheterization. When a fistula is small and cardiac cavity at the opening is not visualized by the angiocardiogram, coronary perfusion scanning successfully disclosed the location of fistula and influence of coronary circulation. (auth)

9318 EFFECT OF KINETIN AND SHADING ON THE SUBSEQUENT DISTRIBUTION OF ^{14}C-ASSIMILATES IN RAPHANUS SATIVUS. Starck, Z. (Szkola Glowna Gospodarstwa Wiejskiego, Warsaw (Poland). Instytut Biologii Roslin). Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 21: 573-580(1973).

Preshading did not influence photosynthetic activity estimated under natural light conditions, independently of some inhibition of the blade growth, but increased rate of photosynthesis, calculated on the dry matter basis. In preshaded plants (50% NL) much less ^{14}C-assimilates migrated to the storage root, but more to the petioles, almost independently of the kinetin treatment. Translocation of the ^{14}C-substances to the fibrous roots decreased in lower proportion, as the effect of preshading, especially in kinetin-treated plants. In leaves detached after 35 min exposure of the whole plant to $^{14}CO_2$, total export (in 2 h) out of the blades decreased as compared with intact plant; ^{14}C-transport to the petioles, in the NL plants was even higher than in preshaded ones, probably owing to elimination of draining of assimilates by the roots, causing depletion of petioles in intact plants. Therefore accumulation of ^{14}C-assimilates in the petioles of intact, preshaded plants may have been effect of diminished pull forces of the roots retarded in growth. In detached leaves kinetin reduced ^{14}C-migration to the petioles of NL-plants in contrast to the preshaded ones. Some changes in the content of sugars and metabolic conversion of ^{14}C-assimilates due to preshading and kinetin treatment are discussed. Kinetin in most cases decreased the effects of etiolation. This substances as well as preshading seems to influence directly the source-path-sink system owing to the changes in metabolic conversion of assimilates. (auth)

9319 THE EFFECT OF SHADING DURING GROWTH ON THE SUBSEQUENT DISTRIBUTION OF ^{14}C-ASSIMILATES IN RAPHANUS SATIVUS. Starck, Z. (Szkola Glowna Gospodarstwa Wiejskiego, Warsaw (Poland). Instytut Biologii Roslin). Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 21: 309-314(1973).

Shading of radish plants for 4 days (50% natural light [NL]) reduced drastically the growth of the storage root and slightly that of all other roots but stimulated growth of petioles without any effect on the blades. Immediately after the shading period, plants from natural light conditions (NL) and preshaded ones (50% NL) assimilated almost the same amount of $^{14}CO_2$ under natural light conditions; nevertheless the pattern of ^{14}C-distribution changed markedly as an effect of preshading: much less ^{14}C-assimilates migrated to the storage root and more to the petioles. Some positive correlation between the relative size of the storage root and ^{14}C-translocation to it was found. In petioles of preshaded plants the rate of ^{14}C-incorporation into the immobile ethanol-insoluble fraction as well as the specific radioactivity of the sugars increased. This may be the direct or indirect effect of decreasing competition for assimilates between petioles and storage root. The higher specific radioactivity detected in ^{14}C-donor organs (blades and cotyledons) of preshaded plants, after a 75 min translocation period, suggests that export of ^{14}C-assimilates decreased probably as a consequence of the lower mobilizing power of the main acceptor – root. (auth)

9320 LABELLED POLYPEPTIDES. IV. Synthesis of [1 – ^{14}C] Glycine ^{10}-α-Melanotropine. Fittkau, S. (Martin-Luther Univ., Halle (German Democratic Republic). Physiologisch-Chemisches Inst.); Medzihradszky, K.; Seprodi, J. (Eotvos Lorand Tudomanyegyetem, Budapest (Hungary)). J. Prakt. Chem.; 316: No. 3, 402-414(1974). (In German).

The pituitary hormone α-melanotropine was prepared by fragment condensation of the N-terminal acetyltetrapeptide with the sequence 5–9 pentapeptide, lengthening of the nonapeptide by (^{14}C) glycine and coupling of the labelled decapeptide with the C-terminal tripeptide amide. Radioactively labelled α-melanotropine of specific activity of 34 μCi/mmol and biological activity of $2 \cdot 10^{10}$ units/g was obtained from the protected acetyltridecapeptide amide by separating the protective groups. (INIS)

MATERIALS

9321 (NIIAR-P-219) INTERPRETATION OF NONPERFECT CRYSTAL DIFFRACTION PICTURE. Sochilin, G. I. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 22p. (In Russian). INIS.

If a general expression of the kinematic theory of diffraction is written by a Paterson function and this function is constructed for known models of nonideal crystals, an obvious and simple relation is obtained between the imperfections of atomic crystal structure and the distribution of scattering intensity on the diffractogram. In the intensities of Lave lines there is information on the configurations of defects existing in real crystals, but the extraction of this information is coupled with enormous experimental difficulties. Diffraction methods have a fundamental feature of "smoothing" the structural imperfections of real crystals. (SJR)

9322 (UCID-16457-74-4, pp 1-6) THEORETICAL EOS GROUP. Grover, R. 1974.

In H-Division quarterly report, October-December 1974.

Activities in programs aimed at development of theoretical techniques for the description of material properties under extreme conditions and the construction of equation of state (EOS) tables for specific materials are described. Results of studies on the shock properties of D_2, ^6LiD, U, and stainless steel are presented. Results of studies on fitting functions for the EOS of dense hydrogen and mixtures of low Z-elements, on the Thom-Fermi EOS in the high-temperature approximation, on the Hugoniot of dense LiH, and on the Ross-Lindemann melting criterion for solids, are also presented. (JRD)

9323 (UCID-16457-74-4, pp 24-30) EXPERIMENTAL EOS GROUP. Young, D. 1974.

In H-Division quarterly report, October-December 1974.

Results of investigations on properties of materials at high pressure and temperature are presented. The equation-of-state (EOS) parameters for a number of materials were determined experimentally. Results of isobaric expansion experiments to measure the properties of liquid Ta are tabulated. Research on methods of measuring the melting point of Fe is reported along with development of methods for high-pressure Hugoniot measurements. (JRD)

9324 (UCID-16457-74-4, pp 31-42) DYNAMIC MATERIALS RESPONSE GROUP. Isbell, W. M. 1974.

In H-Division quarterly report, October-December 1974.

Results of studies concerned with the response of materials to a wide range of pressure, time, and temperature are reported. The studies are conducted by combining theory, computations, and experiments to provide computer simulation of complex phenomena. Major efforts include: (1) constitutive modeling and experimental characterization of porous metals, (2) advanced experimental diagnostics for shock-wave and electron-beam studies, and (3) development of gages for measurement of impulses created in underground test environments. Recent developments include completion and experimental verification of a new constitutive model for wave propagation in porous materials, completion of experimental studies of stress generation in porous metals arising from rapid radiant energy deposition, completion of an interferometric system capable of measuring shock-wave parameters at megabar pressures, and completion of an experimental evaluation of the electromechanical risetime of a recently developed impulse gage for use in underground testing. (JRD)

Ceramics and Cermets

Refer also to abstracts 8493, 8580, 9372–9374, 9382, 9396, 9409, 9496, 9543–9545, 9580, 9587, 10781, 10872, 10941, 10967, and 11092.

9325 (AD-907330) CUBIC BORON NITRIDE: HANDBOOK OF PROPERTIES. Devries, R. C. (General Electric Co., Schenectady, N. Y. (USA)). Jun 1972. 19p. NTIS $3.25.

A critical compilation of the crystallographic, mechanical, optical, electrical, thermal, and thermodynamic properties of cubic BN is assembled in table form with explanatory text and figures. (GRA)

9326 (CEA-CONF-2920) IRRADIATION OF URANIUM AND PLUTONIUM CARBIDES WITH SODIUM JOINT: FORMATION OF CARBIDES IN THE CLADDING. Mikailoff, H.; Housseau, M.; Erler, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). 1974. 4p. (In French). INIS.

From European conference on irradiation behaviour of fuel cladding and core component materials; Karlsruhe, F. R. Germany (3 Dec 1974).

The results of tests on carbide formation performed outside the pile at 700 deg C, and of analyses and tests carried out on the cladding of fuel elements irradiated in Rapsodie, are reported. They show that carbon transfer takes place preferentially towards the hottest part of the cladding and that irradiation probably speeds up diffusion in the steel and in the carbide. (FR)

9327 (CONF-730571-, pp 253-259) STUDY OF SOME SYSTEMS FORMED BY THORIUM DIOXIDE WITH RARE EARTH SESQUIOXIDES. Sibieude, F. (CNRS, Font-Romeu, France). 1973. (In French).

From colloquium on x rays and matter; Monte Carlo, Monaco (22 May 1973).

In colloquium on x rays and matter, Monte Carlo, Monaco, May 22-26, 1973.

The study of different phases of $ThO_2-Ln_2O_3$ systems was made by x-ray diffraction by using a method allowing powder diagrams to be obtained at temperatures from room temperature up to the vicinity of 2500°C. Complementary data obtained by direct thermal analysis of fused samples led to the proposal of probable phase diagrams for each system studied. (tr-auth)

9328 (CONF-750542-1) HOT PRESSING OF URANIUM NITRIDE AND MIXED URANIUM PLUTONIUM NITRIDE. Chang, J. Y. (Oak Ridge National Lab., Tenn. (USA)). 1975. 18p. Dep. NTIS $4.00.

From 77th annual meeting of the American Ceramic Society; Washington, District of Columbia, USA (3 May 1975).

The hot pressing characteristics of uranium nitride and mixed uranium plutonium nitride were studied. The utilization of computer programs together with the experimental technique developed in the present study may serve as a useful purpose of prediction and fabrication of advanced reactor fuel and other high temperature ceramic materials for the future. The densification of nitrides follow closely with a plastic flow theory expressed as: d rho/dt equals A/T(t) (1-rho) [1/1-(1-rho)/sup $\frac{2}{3}$/ + Bln (1-rho)]. The coefficients, A and B, were obtained from experiment and computer curve fitting. (8 figures) (auth)

9329 (JUL-1106-RW, pp 27-50) IMPROVEMENTS IN CHARACTERIZATION METHODS OF PYROCARBON. Luhleich, H.; Koizlik, K.; Wallura, E.; Hoven, H.; Cremerius, M.; Holliday, J.; Frampton, D. P.; Allen, S.; Hedderley, J. C. Sep 1974.

From 8th meeting of the Dragon Project Quality Control Working Party; Winfrith, UK (11 Jun 1974).

In quality control procedures on graphite, pyrocarbon and siliconcarbide. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Readtorwerkstoffe und Heisse Zellen).

Based upon the two component model of pyrocarbon the improvements in characterization methods, the plasma- and wet oxidation methods, the ultrasonic method, and a grinding method for the determination of density profiles are described. The application of the plasma- and wet oxidation methods to specification tests is discussed. Also, first results of a further new method, scanning electron microscopy (SEM) are given. (auth)

9330 (JUL-1106-RW, pp 51-60) DETERMINATION OF STRENGTH AND YOUNG'S MODULUS OF PYROCARBON- AND SILICON CARBIDE LAYERS OF COATED FUEL PARTICLES. Bongartz, K.; Schuster, H.; Taeuber, K. Sep 1974.

From 8th meeting of the Dragon Project Quality Control Working Party; Winfrith, UK (11 Jun 1974).

5 figs.; 1 tab.; 1 ref. With abstract.

In quality control procedures on graphite, pyrocarbon and siliconcarbide. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen).

A method to measure strength and Young's Modulus on SiC- or pyrocarbon-ring-specimens prepared out of coating material deposited on HTR fuel particles was developed by KFA. By this method difficulties in the interpretation of the measured values which arise if measurements are performed on materials deposited on discs should be avoided. Stress calculations for the coating of particles with SiC interlayer show that during the end phase of irradiation the SiC layer has to carry the main load. Therefore, the mechanical properties of the SiC are mainly responsible for the mechanical integrity of the whole coating of the particle. For that reason mainly SiC properties have been measured so far. As simple rings are employed in the measurement, the mathematical analysis is easy and no significant corrections are necessary. (auth)

9331 (JUL-1106-RW, pp 61-74) MICROPOROSITY. A Characteristic Property of Pyrocarbon Coatings. Krautwasser, H. P. Sep 1974.

From 8th meeting of the Dragon Protect Quality Control Working Party; Winfrith, UK (11 Jun 1974).

12 figs. With abstract.

In quality control procedures on graphite, pyrocarbon and siliconcarbide. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen).

Small angle X-ray scattering was used as a new sensitive method for microporosity measurements for the characterization of pyrocarbon. The main aims of the microporosity measurements were to study the influence of deposition parameters on the microstructure of the pyrocarbons; comparison of microstructure and irradiation behavior; association of the empirically specified deposition rate with a structural state of the pyrocarbon coatings; and examination of the change in the material during heat treatment and irradiation. (GE)

9332 (JUL-1106-RW, pp 75-94) TRANSMISSION ELECTRON MICROSCOPY OF PROPENE-DERIVED PYROLYTIC CARBON COATINGS. Yust, C. S.; Krautwasser, H. P. Sep 1974.

From 8th meeting of the Dragon Project Quality Control Working Party; Winfrith, UK (11 Jun 1974).

10 figs.; 1 tab.; 5 refs. With abstract.

In quality control procedures on graphite, pyrocarbon and siliconcarbide. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen).

Transmission electron microscopy was applied for the evaluation of specific coating characteristics of propene-derived pyrolytic carbon. The coatings were formed in a fluidized bed on spherical particles. The deposition temperature was varied between 1,250 and 2,000°C in order to study the effect of this important deposition parameter on the coating structure. Dependent on this parameter, structural changes were observed corresponding to measured changes in density and in pore size distribution. The results of this study were compared with previous work carried out by others. The coatings they studied were deposited on flat discs in a fluidized bed. (GE)

9333 (N-74-33401) FREE SUSPENSION PROCESSING OF OXIDES TO FORM AMORPHOUS OXIDE MATERIALS, APPENDIX B. Wouch, G. (General Electric Co., Philadelphia, Pa. (USA)). 1 Nov 1973. 24p. NTIS.

The processing of yttria, zirconia, and alumina under weightless conditions is discussed. The process consists of levitation or position control, heating and melting, superheating, and supercooling. The use of arc imaging furnaces, lasers, induction heating, microwave, and electron beam methods are analyzed to show the advantages and disadvantages of each. (STAR)

9334 (N-75-11727) CONTINUATION OF DEVELOPMENT OF NITRIDES FOR SPACE NUCLEAR REACTORS. Final Report. Potter, R. A.; Scott, J. L. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. 21p. (NASA-CR-134498; ORNL-TM-4496). NTIS $3.25.

Alloy nitrides (U, Zr), (U, Ce), and (U, Y) were prepared and exposed to vacuum at temperatures to 1700°C and compared with pure UN. Weight loss data and physical observations showed that the alloy samples were more stable than UN. In weight loss, (U, Zr)N was 3 times as stable as UN at 1600°C for 100 h at 0.000002 torr (0.000266n/sq.m.). (STAR)

9335 (TRG-Report-2627(S)) REFEL SILICON CARBIDE. The Development of a Ceramic for a Nuclear Engineering Application. Kennedy, P.; Shennan, J. V. (UKAEA Reactor Group, Springfields). Oct 1974. 18p. (CONF-741096-1). Dep. NTIS (US Sales Only) $4.00.

From 3rd materials conference on turbine applications; Ann Arbor, Michigan, (28 Oct 1974).

REFEL silicon carbide is a strong, uniform, fine-grain material which retains its strength and is stable in an oxidizing environment up to 1400°C. REFEL silicon carbide tube can be produced in quantity and by a combination of process controls, visual examination, NDT and proof testing, and a very consistent product can be made. The material was developed as a nuclear fuel cladding capable of operating at temperatures of 1100°C in a CO_2-cooled reactor and the combination of excellent physical, mechanical, and chemical properties together with product consistency have confirmed the feasibility of this application. In a series of irradiation experiments REFEL silicon carbide-clad fuel pins have behaved predictably. At irradiation temperatures below about 800°C, the thermal conductivity falls sharply, the associated thermal stress increases, and the probability of failure, for the same rating, increases. It has been demonstrated theoretically that this effect can be overcome by halving the tube wall thickness. In addition to the thermal stress enhancement, the strength and Weibull modulus also fall under irradiation and consequently the safe working stress is reduced. Calculations show that in the absence of irradiation a fourfold increase in rating could be tolerated. Thus the material should have excellent thermal stress resistance in non-nuclear applications such as gas turbine components. (auth)

9336 ACTINIDE PNICTIDES AND CHALCOGENIDES. IV. X-ray Search for Tetragonal Distortion in UN and UAs in the Antiferromagnetic State. Marples, J. A. C.; Sampson, C. F.; Wedgwood, F. A.; Kuznietz, M. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Phys., C (London); 8: No. 5, 708-716(7 Mar 1975).

A single crystal of UN was studied at low temperatures by x-ray diffraction. Below the Néel temperature (~ 55°K) a very small tetragonal distortion (c/a = 0.99935 at 4.2°K) of the NaCl-type lattice was observed, which is consistent with the tetragonal (type I) antiferromagnetic structure inferred from neutron diffraction. A small discontinuity in the lattice spacing of UAs was observed at the transition (around 60°K) from type I to type IA antiferromagnetic ordering (at low temperatures). (auth)

9337 POSITRON ANNIHILATION IN SOME ANTIFERROMAGNETIC MATERIALS. Kulkarni, V. G.; Dave, N. K. (Tata Inst. of Fundamental Research, Bombay). pp 303-305 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

Positron lifetimes and intensities were studied as a function of temperature for antiferromagnetic CoO, Cr_2O_3, MnTe, and V_2O_3. The intensity of the long-lived component showed a decrease below the Neel temperature for CoO and Cr_2O_3, the transition being sharper for CoO. The intensity did not show significant variation with temperature above or below the transition temperature, and the lifetimes did not vary within the observed temperature ranges. No temperature effects were observed for MnTe, while the intensity varied in a complex way for V_2O_3. (PMA)

9338 DIFFUSION ANALYSES FOR SYSTEMS OF SPHERICAL PARTICLES. Stark, W. A. Jr. (Los Alamos Scientific Lab., NM). Nucl. Technol.; 26: No. 1, 35-45(May 1975).

An analytical treatment for the extraction of diffusion coefficients from gas effusion data considers several cases: (a) diffusion from spheres in which the initial gas distribution results from generation of gas within the sphere; (b) diffusion from spheres in which the initial gas distribution results from incomplete, external infusion; and (c) diffusion from collections of spheres of variable size. For the last, the size distribution functions examined are the square, the normal, and the log-normal distributions. The analytical models for extracting diffusion coefficients for the initial conditions are developed. The deviations from the results of the simple classical analysis, which assumes uniform particle size and uniform initial gas concentration, are examined. It is shown that errors of factors of 1.5 to 100 can arise if the classical analysis is used. (auth)

9339 INFLUENCE OF COMPOSITION AND THERMOMECHANICAL CONDITION ON MECHANICAL PROPERTIES OF TaC AND TaB STRENGTHENED CHROMIUM. Filipi, A. M. Metall. Trans.; 5: No. 6, 1423-1427(1974).

Mechanical properties were related to composition and condition for Cr alloys strengthened with TaC, TaB, and TaC + TaB. A 0.25 to 1.00 mole percent alloying range was investigated. Thermomechanical condition had a similar influence on high-temperature strength of the three alloy types. Tensile strengths were highest for heavily warm worked material. Maximum rupture strengths were obtained in the solution treated and aged condition. Composition and alloy content had major influences on rupture properties. Rupture strength was greatly improved by using the alloying phases together as opposed to individually, and a possible synergistic effect was measured. A strong direct relationship between alloy content and the stress dependency of rupture life was observed. Some improvement in low-temperature ductility was obtained by heat treatment and an increase of alloy content, but the lowest ductile-to-brittle transition temperature measured was 300°F. Precipitation of the strengthening phases in Cr was also evaluated from electron microscopy and crystallographic data. A (100) habit was identified for the carbide and postulated for the boride. (Metals Abstr.)

9340 SYNTHESIS AND MAGNETIC BEHAVIOR OF GdN. Cutler, R.A.; Lawson, A.W. (Department of Physics, University of California, Riverside, California 92502). J. Appl. Phys. 46: No. 6, 2739-2744 (June 1975).

New procedures, employing the use of fractional distillation, have been developed for the synthesis and purification of GdN. Distilled and

undistilled GdN exhibit different magnetic behavior, both being sensitive to oxygen impurities. The zero field magnetic moment of a virgin sample of distilled GdN is zero but with increasing field exhibits features of ferromagnetic behavior. For distilled GdN, an increase in oxygen concentration from 0.8 to 5.8 at.% decreases the paramagnetic Curie temperature from 90 to 60 K. Undistilled GdN, having a large nitrogen deficiency, shows ferromagnetic behavior. (auth)

9341 THE UPPER CRITICAL FIELD OF RF—SPUTTERED WN_x AND MoN_x FILMS. Reichelt, K.; Bergmann, G. (Institut für Festörperforschung, Kernforschungsanlage Jülich, D-517 Jülich, Germany). J. Appl. Phys. 46: No. 6, 2747-2751 (June 1975).

The upper critical field and other electronic properties, such as resistivity, temperature coefficient of resistance, and the Hall constant of rf-sputtered WN_x and MoN_x films were measured. It was observed that the upper critical field is independent of the nitrogen partial pressure, whereas the resistivity is strongly affected. The structure and diffraction patterns of these films were also investigated by transmission electron microscopy (TEM). Our measured results are interpreted in terms of the influence of microscopic regions, which affect differently the normal and superconducting properties, as is found for NbN_x films. (auth)

9342 DIE SETS FOR COMPACTING GRANULAR MATERIAL. Warner, D. A. (to United Kingdom Atomic Energy Authority). British Patent 1,367,352. 18 Sep 1974. Filed date 12 Jul 1971. 4p.

Die sets for compacting granular fissionable materials used in compacted fuel elements are described. The die set comprises two co-axial cylinders bounding an annular compaction void. Two opposed annular plungers slidable in the void are provided along with two opposed pairs of co-axial helical coil compression springs reacting between the ends of the cylinders and the plungers. A means of limiting the extent of compaction is also provided. (JRD)

9343 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF ARTICLES COATED WITH SILICON CARBIDE. Ford, L. H.; Davidge, R. W.; Evans, A. G. (to United Kingdom Atomic Energy Authority). British Patent 1,367,466. 18 Sep 1974. Filed date 8 Jan 1971. 5p.

A method of producing SiC-coated fuel particles is described. A coating of pyrolytic SiC is vapor deposited on carbon-coated fuel kernels in fluidized bed. Details of the deposition process are given. (JRD)

9344 SUBSOLIDUS EQUILIBRIUM DIAGRAM AND STABILITY OF FLUORITE-LIKE SOLID SOLUTIONS IN THE HfO_2–MgO SYSTEM. Kuznetsov, A. K.; Tikhonov, P. A.; Kravchinskaya, M. V. Zh. Neorg. Khim.; 20: No. 3, 758-760(Mar 1975). (In Russian).

Using x-ray, phase chemical analysis, and measurement of electroconductivity, studies were made on subsolidus equilibriums in HfO_2–MgO systems and on the stability of cubic solid solutions of MgO in HfO_2. It was established that the phase diagram of the HfO_2–MgO system is of the eutectoid type and that temperature and concentrations at the eutectoid point are 1500°C and 18 mole % MgO, respectively. (tr-auth)

9345 PHYSICO-CHEMICAL TRANSFORMATION OF VANADIUM PENTOXIDE BY THE ACTION OF SHOCK WAVES. Anan'in, A. V.; Breusov, O. N.; Dremin, A. N.; Drobyshev, V. N.; Pershin, S. V. Zh. Neorg. Khim.; 20: No. 3, 571-575(Mar 1975). (In Russian).

Physico-chemical changes in vanadium pentoxide were studied after the action of strong shock waves. The shock action was accomplished by a method in which the substance was kept in a closed volume. It was shown that under these conditions vanadium pentoxide undergoes physico-chemical changes accompanied by formation of phases of the type V_xO_2 with $x \approx 0.8$ and crystallization in the monoclinic crystal system with the parameters $a = 11.72$, $b = 8.96$, $c = 5.37_4$ Å, and $\beta = 123°40'$, phases close to the composition V_3O_4, and having a cubic structure of the spinel type with $a = 8.457$ Å. (tr-auth)

9346 NOTE ON CRYSTALLINE BINDING IN URANIUM DIOXIDE AND ITS EFFECT ON THE DOPPLER BROADENING OF URANIUM RESONANCES. Butland, A. T. D. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). Ann. Nucl. Sci. Eng.; 1: No. 11/12, 575-577(Nov 1974).

The weighted phonon frequency spectra developed for U and O in UO_2 by Thorson and Jarvis (1969) are used to deduce the effective temperatures for these two nuclides, and some comments are made on the effect of crystalline binding in UO_2 on the temperature broadening of resonances in uranium. (auth)

9347 CRYSTAL FIELD SPLITTINGS OF NdN. Warming, E.; Bak, P. (Danish Atomic Energy Commission, Risoe). J. Phys., C (London); 8: No. 7, 1054-1058(7 Apr 1975).

The crystal field levels of the Nd($J = 9/2$) ion in NdN have been determined by inelastic neutron scattering. The crystal field parameters obtained by a least-squares fit to the spectra at 80°K are: $B_4 = -0.042 \pm 0.002$°K and $B_6 = -0.00042 \pm 0.00002$°K. This result contrasts with the point charge model used to interpret previous measurements of other rare earth pnictides [Birgeneau et al., Phys. Rev.; B8: 5345 (1973)]. (auth)

9348 EXAMINATION OF TELLURIUM ION-IMPLANTED GaAs BY TRANSMISSION ELECTRON MICROSCOPY. Sealy, B. J. (Surrey Univ., Guildford, Eng.). J. Mater. Sci.; 10: No. 4, 683-691(Apr 1975).

The effect of implanting high energy tellurium ions into single crystal GaAs has been investigated by transmission electron microscopy. Results from annealing experiments on specimens implanted at room temperature show that two anneal stages centered near 200 and 600°C occur, the actual anneal temperature being dose dependent. Non-crystalline surface layers were formed after implanting doses in the range 5×10^{13} to 5×10^{15} ions cm^{-2} at room temperature. However, implanting similar doses at 180°C caused no change in crystallinity. Thus the low temperature anneal stage which is the epitaxial recrystallization of the non-crystalline material does not occur for the higher implant temperature. The high temperature anneal stage is associated with the annealing out of tiny defects such as twins and/or stacking faults leaving a single crystal containing only dislocation loops. The anneal stages observed by electron microscopy correlate with changes in sheet resistivity and Rutherford backscattering measurements on similar material. It is suggested that changes in dislocation loop size and density at high temperatures are coincident with the attainment of electrical activity. (auth)

9349 ELECTRON MICROSCOPE STUDY OF WO GROWN ON (110), (001), AND (111) SURFACES OF W. Jaeger, H.; Sherwood, R. G. (Univ. of Melbourne, Parkville, Australia). Jap. Appl. Phys.; No. Suppl. 2, 97-100(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Oxide formed when (110), (001) and (111) surfaces of W are oxidized grows as single crystal whiskers with the growth axis in ⟨001⟩ type oxide directions. Closely spaced faults were observed on {310} type planes parallel to the axis. (auth)

9350 INVESTIGATION OF EuO (100)-CLEAVAGE SURFACE BY LEED AND AES. Bas, E. B.; Baenninger, U.; Muehlethaler, H. (Swiss Federal Inst. of Tech., Zurich). Jap. Appl. Phys.; No. Suppl. 2, 671-673(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The (100)-cleavage surface of EuO was investigated by LEED and AES. The cleavage was prepared in a LEED-system at a background pressure of about 3×10^{-11} Torr. LEED patterns of just cleaved surface showed square structure composed of strong reflections with $h + k$ = even and weak reflections with $h + k$ = odd. The odd reflections disappeared with time and the pattern became that expected for the NaCl-type crystals. The Auger-electron spectrum of the surface shows a group of strong peaks at about 79, 100, 120 and 138 eV. The 100 eV-peak is about five times stronger than the 515 eV-oxygen peak for a primary electron energy of 2.5 keV. This peak group can be identified as $N_{4,5}$-spectrum of europium. At low primary energies a strong loss peak at 142 eV loss energy and weaker peaks at 258 eV and 359 eV were observed, and can be identified as $N_{4,5}$, N_3 and N_1 loss peaks of europium. (auth)

9351 HIGH TEMPERATURE VAPORIZATION BEHAVIOR OF THE NEODYMIUM SESQUIOXIDE PHASE. Tetenbaum, M. (Argonne National Lab., IL). High Temp. Sci.; 7: No. 1, 37-43 (Mar 1975).

The vaporization behavior of the neodymium sesquioxide phase has been studied as functions of oxygen partial pressure in the temperature range 2155 to 2485°K by means of a transpiration technique. For the assumed reaction $Nd_2O_3(s) = 2NdO(g) + \frac{1}{2} O_2(g)$, the third law heat of reaction was found to be $\Delta H_0^\circ = 361.1 \pm 1.1$ kcal/mole. The heat of formation and dissociation energy of NdO(g) derived from this study was ΔH_f° (NdO, g, 0 K) = -33.7 ± 0.6 kcal/mole and D_0°(NdO, g) = 7.42 ± 0.1 eV, respectively. Oxygen deficient compositions O/Nd = 1.48 to 1.49 were obtained. (auth)

9352 METHOD FOR COATING URANIUM IMPREGNATED GRAPHITE WITH ZIRCONIUM CARBIDE. Newbury, R. S.; Tully, G. R. Jr. (to U. S. Atomic Energy Commission). US Patent 3,865,614. B44d5/12. 11 Feb 1975. Filed data 2 Apr 1959. 5p.

PAT-APPL-803,810.

A process for producing a tenacious zirconium carbide coating on graphite impregnated with uranium is described. Porous graphite is impregnated with uranyl nitrate dissolved in tertiary

butyl alcohol, enveloping the graphite in clean tertiary butyl alcohol solvent dissolves the uranyl nitrate dihydrate impregnant from the surface of the graphite into a liquid. The graphite is enveloped in liquid nitrogen to freeze the impregnated solution. The frozen solvent is evaporated from the impregnated solution and the uranyl nitrate dihydrate is deposited in the graphite pores and converted to uranium carbide by the application of heat. A coating of finely divided zirconium suspended in liquid containing a carbonaceous binder is deposited on the graphite surface, the liquid is evaporated and the zirconium is converted to carbide by the application of heat, forming a zirconium carbide coating. (auth)

9353 UO_2BeO FUEL PROCESS. Rubin, J. A.; Johnson, P. D. (to U. S. Atomic Energy Commission). US Patent 3,865,746. C09k3/00. 11 Feb 1975. Filed date 16 Jul 1959. 4p.
PAT-APPL-827,661.

A method of forming a UO_2–BeO ceramic body is described which comprises melting together uranium nitrate and beryllium nitrate to a temperature of approximately 50 to 100°C, heating the resulting melt until a homogeneous mixture of beryllium oxide and uranium oxide is obtained, hot-pressing the resulting composition at 1200 to 2000°C, at a pressure of 1000 to 6000 psi for one-half to 6 hours. (auth)

9354 METHOD OF PRODUCING AN OXIDATION-RESISTANT UO_2 FUEL BODY. Rubin, J. A. (to U.S. Atomic Energy Commission). US Patent 3,867,489. G21c20/00. 18 Feb 1975. Filed date 17 Jul 1962. 3p.
PAT-APPL-210,880.

A method of forming a UO_2 fuel body resistive to oxidative attack is described, which comprises mixing UO_2 and a ceramic oxide of relatively low thermal neutron absorption cross section, adding to the resulting mixture a small amount of a compound selected from the class consisting of alkali metal halides, and alkaline earth metal halides, and then forming a fuel body of the resulting composition. (auth)

9355 ABRASIVE WEAR RESISTANCE AND RUPTURE OF THE SURFACE LAYERS OF TITANIUM AND ZIRCONIUM BORIDES. Dan'kin, A. A.; Svetlopolyanskaya, T. P.; Oreshkin, V. D.; Svetlopolyansky, V. I. Porosh. Met., Akad. Nauk Ukr. SSR; No. 7, 88-92(Jul 1974). (In Russian).

The abrasive wear resistance of TiB_2 and ZrB_2 was studied in conjunction with an analysis of the mechanisms underlying the disintegration of the surface layers, and the results were compared with the fundamental configuration of the constituent elements, e.g., their stable electron configurations per se, and in combination with other elements. Under the influence of a two-phase flow (abrasive jet) the degree of wear was largely determined by the angle of attack (the greatest wear occurring at an angle of 60°), the microhardness, the ductility of the materials, and the degree of localization of their valence electrons in the stable sp^2 and sp^3 configurations. The wear resistance of these materials was 7–10 times that of Cr–Ni steel Kh18N10T. (Metals Abstr.)

9356 EFFECT OF SHOCK WAVES ON REFRACTORY COMPOUNDS. III. Lanthanum Hexaboride. Anan'in, A. V. Porosh. Met., Akad. Nauk Ukr. SSR; No. 8, 74-79(Aug 1974). (In Russian).

The effect of shock waves on the structure and physical and mechanical properties of LaB_6 was studied. The samples were taken in powder form and subjected to shock waves with pressures of up to 350 kbar. This process caused a redistribution of particle size and shape such as to create a far more compact structure than that of similar powders subjected to simple moulding and sintering. After treatment with shock waves, the material subsequently sintered at 2100°C had a residual porosity of <10%, whereas in the absence of shock waves the porosity was twice this, even for a sintering temp. of 2400°C. (Metals Abstr.)

9357 FIRED MICROSTRUCTURE OF FREEZE-DRIED, LIME-STABILIZED ZIRCONIA. Wheat, T. A. (Dept. of Energy Mines and Resources, Ottawa). J. Can. Ceram. Soc.; 43: 5-14 (1974).

Data are presented showing the effect of processing variables on the fired microstructure of freeze-dried, lime-stabilized zirconia. It has been shown that the single most important parameter which controls the development of a high-density body during firing is the degree of dispersion of the raw material prior to the initial fabrication stage. Other variables such as fabrication pressure, rate of binder burnout, heating rate, sintering atmosphere, firing temperature, and time at maximum temperature were found to have only a minor influence on the fired density. (auth)

9358 INVESTIGATION OF THE STRUCTURE OF THE SURFACE OF IRRADIATED ALUMINUM OXIDE CONTAINING URANIUM TRIOXIDE. Nadykto, G. T.; Bogdanova, E. A. Sov. At. Energy (Engl. Transl.); 37: No. 3, 973-975(Sep 1974).
Translated from At. Energ. (USSR); 37: No. 3, 255-257(Sep 1974).

The surface structure of neutron irradiated γ-aluminum oxides, including samples containing 11% by weight UO_3, was studied by the method of low-temperature adsorption of nitrogen (T = 195.8°C) and x-ray diffraction. The adsorption isotherms of irradiated and nonirradiated samples are compared, and show substantial differences. The x-ray diffraction data show that the irradiation of γ-Al_2O_3 decreases the size of the primary blocks of crystallites from 67 to 63 Å without changing the lattice constant, while the irradiation of γ-Al_2O_3 containing uranium trioxide leads to a substantial decrease (from 61 to 43 Å), the lattice constant in this case increasing somewhat. (auth)

9359 INFLUENCE OF RADIATION DAMAGES ON DISACCOMMODATION IN THE Mn–FERRITES. Dindun, S. S.; Kovtun, A. P.; Raitman, E.; Ulmanis, U. A. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 6, 8-11(1974). (In Russian).

The effect of neutron irradiation on the temperature spectra of disaccommodation (DA) in the $Mn_xFe_{3-x}O_{4+\gamma}$ ferrites with x = 1,02 and $-0.025 < \gamma < +0.013$ is investigated. After irradiation, the new temperature peaks occur in temperature spectra of Da, their values being dependent on the irradiation dose and γ. (auth)

9360 CORROSION BEHAVIOUR OF ZIRCALOY-2 TUBES IN WATER VAPOUR UNDER THE INFLUENCE OF STRESS. Wiedemann, K. H. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Z. Metallkd.; 65: No. 12, 735-738 (Dec 1974). (In German).

The corrosion behavior of Zircaloy-2 canning tubes with tensile and compressive stresses in the tube wall was investigated at temperatures ranging from 350 to 500°C and were compared with that of Zircaloy-2 sheet specimens. Apart from the well known increase in thickness of the oxide layer with increasing temperature and time, tangential tensile stresses in the tube wall and tensile stresses in the sheet increase the corrosion attack and shift the transition point from parabolic to linear oxide growth to shorter times. Compressive stresses in the tube wall do not increase the rate of corrosion attack. An influence of the pressure of the cooling agent could not be detected. Within the range of variation of the experimental conditions the pick-up of hydrogen by the tube specimens during water vapor corrosion increases linearly with the thickness of the oxide layer independent of temperature, time, pressure of the cooling agent, and mechanical stress in the tube wall. Tangential tensile and compressive stresses of 6 kp/mm² in the tube wall do not influence the orientation of the precipitated hydrides. (auth)

9361 MIXED CARBIDES OF Ta AND Hf AND THEIR REACTIONS WITH POSSIBLE BINDING METALS. Holleck, H.; Scholz, B.; Schneider, H.; Thuemmler, F. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung; Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Werkstoffkunde 2). Z. Metallkd.; 65: No. 12, 738-747(Dec 1974). (In German).

From 8th plansee-seminar on heat-resisting and wear-resisting sintered materials;Reutte/Tyrol, Austria (27 May 1974). 16 figs.; 2 tabs.; 30 refs. Part of the thesis by Scholz, B.

Hard metal specimens of the system Ta–Hf–C, partly with MoCsub(1-x) and WCsub(1-x) additions, were produced by melting and by powder metallurgical methods and their hardness was tested up to 1,600°C. The maximum values were obtained in the solid solutions deficient in carbon. Sub-stoichiometric carbides are more prone to chemical interactions with the binding metals Co and Ni because of their higher metal activity compared to stoichiometric carbides. This is particularly pronounced with HfC and somewhat less with TaC base hard metals. Investigations of the wetting behaviour showed a higher contact angle for the mixed carbides than for the pure carbides and an increase in the angle with increasing carbon defect concentration. According to these investigations nickel is more suitable as a binding metal than cobalt. The densification by hot pressing with different binding metals and the hardness of these systems up to 1,000°C are given. (auth)

9362 SINTERING OF WC–Co ALLOY IN HYDROCARBON–HYDROGEN MIXTURES. Nissenholts, Z.; Barta, J. (Ministry of Defense, Tel Aviv, Israel). Planseeber. Pulvermet.; 22: No. 2, 81-90(Jun 1974).

WC–Co-specimens were sintered in hydrocarbon–hydrogen mixtures for the purpose of evaluating new methods of carbon control in these alloys. Methane–hydrogen, toluene–hydrogen, and cooking gas hydrogen sintering atmospheres were used and in each case, the proper hydrocarbon content of the gas mixture determined to obtain the right carbon content of the alloy. The

properties of the alloys were similar to those obtained by using usual sintering practice. The possibility of using hydrocarbon–hydrogen mixture in sintering WC–Co alloy was demonstrated on a laboratory scale. (auth)

9363 ELECTRICAL CONDUCTIVITY OF A PSEUDOLIQUEFIED LAYER IN AN ELECTRIC FIELD. Gal', V.V.; Konov, V.I.; Nikitin, K.A. (Institute of High Temperature, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Tech. Phys. 19: No. 9, 1214-1215 (Mar 1975).

The electrical conductivity of pseudoliquefied layers of graphite, niobium, and zirconium oxycarbonitride is investigated in a weak electric field, i.e., below 1 V/cm. It is shown that an electric current can flow through pseudoliquefied zirconium oxycarbonitride and niobium layers only above a threshold voltage, the breakdown voltage. The dependence of the breakdown voltage on the experimental parameters is investigated. The results are evaluated in connection with contact conductivity and the breakdown of thin dielectric oxide layers on particle surfaces. (auth)

9364 REACTIONS OF URANIUM DIOXIDE WITH MELTS OF THE SYSTEM Cu–Al–Zr. Pastushkov, V. G.; Novoselov, G. P.; Borisov, G. B. Sov. At. Energy (Engl. Transl.); 37: No. 3, 979-980(Sep 1974).

Translated from At. Energ. (USSR); 37: No. 3, 259-260(Sep 1974).

The probability of reactions between UO_2 and melts of various Cu, Al, and Zr alloy combinations was studied between 298 K and 2000 K by measuring the amount of uranium entering the metallic phase. Thermodynamic analysis revealed that uranium dioxide is not reduced by Cu or a Cu–30 wt% Al alloy at 13 C. The most probable reaction was found to be UO_2 with aluminum and zirconium.

9365 TiC-BASED CARBIDES WITH SUB-STOICHIOMETRIC CARBON CONTENT OF THE CARBIDE PHASE. Fister, D.; Kieffer, R. (Inst. for Chemical Tech., Vienna). Planseeber. Pulvermet.; 22: No. 3, 175-187(Sep 1974). (In German).

The influence of 5a-carbide additives and the understiochiometric carbon content of the carbide phase on the properties of TiC–Mo_2C–Ni cemented carbides were investigated. The best values of TRS were found at 88 to 95% of the theoretical carbon content of the carbide phase. The influence of a carbon defect on the hardness is not very significant. With NbC-additives of maximum 15% the best values of TRS were obtained (1650 N/mm²). The highest hardness was found using VC in the carbide phase (1650 HV3). The oxidation-resistance of the NbC and TaC containing alloys is extremely good. But at higher amounts of NbC (TaC) in the carbide phase (more than 15 to 20%) the resistance to scaling becomes worse. VC-contents in the alloys are also not favorable. Cutting tests showed that cratering of the TiC–Mo_2C–(TaC, NbC, VC)–Ni alloys is better than the crater-wear of an ISO-P10 standard. (auth)

9366 EFFECT OF CARBON CONTENT AND SINTERING TEMPERATURE ON STRUCTURE FORMATION AND PROPERTIES OF A TiC–24% Mo–15% Ni ALLOY. Snell, P. O.; (Fagersta Seco A. B., Sweden). Planseeber. Pulvermet.; 22: No. 2, 91-106(Jun 1974).

Investigations of the microstructure and composition of the binder and carbide phases in TiC–Mo–Ni hard alloys have revealed some new facts about the relationships between physical properties and the structural parameters of these alloys. It has been shown that the principles used for the study of WC–Co or WC–TiC–TaC–Co-alloys can in general also be applied to TiC–Mo–Ni hard alloys. However, for the latter alloys the relationships between microstructural composition and physical properties, and thus also application properties (e.g. wear rate in turning), exhibit certain important differences from those which apply to "conventional" cemented carbide systems. The zone microstructure of the carbide phase of the TiC–Mo–Ni alloys, which could also be described as a "coaxial" carbide structure, seems to regulate the mechanical properties of the alloys. It was found that the coaxial carbide structure of the TiC–Mo–Ni alloys consisted of a core of pure TiC and a boundary zone around the core consisting of a mixed carbide of Ti and Mo. It could also be shown that the overall grain size of the carbide phase increased with increasing sintering temperature in a manner similar to that found in conventional carbides. However, in the "coaxial" carbide phase the grain growth occurs mainly by the growth of the boundary zone, the core of the carbide phase being nearly unaffected by the increase of the temperature in the range 1350 to 1500° C. In these alloys there is a critical carbide grain size (2 to 3 μm) at which a transition occurs from intercrystalline to transcrystalline fracture. However, the fracture path also seems to be affected by the thickness of the boundary zone. Another important feature influencing the formation and growth rate of the boundary zone of the coaxial carbide phase and the composition of the binder phase is the carbon content of the alloy. It has been found that the TiC–Mo–Ni alloys exhibit a decrease in grain size with increasing carbon content. Furthermore, with an increasing carbon content the dissolution of Ti and Mo in the Ni binder phase decreases. The mechanical properties of the alloys seem to be regulated mainly by the grain size and the nature of the coaxial structure. The influence of the binder phase composition on the mechanical properties has been completely masked by the high Mo content and the resultant changes in the microstructure in the alloys studied. A more detailed study of the relation between binder phase composition and mechanical properties would probably yield information of value for the development of new high-strength TiC–Mo–Ni alloys. (auth)

9367 VOLUME DIFFUSION IN THE WC–TiC SYSTEM AND ITS EFFECTS ON MIXED CARBIDE FORMATION. May, W.; Kraemer, E. (Krupp–Forschungsinstitut, Essen). Planseeber. Pulvermet.; 22: No. 2, 107-117(Jun 1974). (In German).

Diffusion experiments were carried out on WC–TiC pairs in the temperature range 2200 to 2500° C. WC single crystals having a side length of several mm were embedded in TiC powder (particle size ~ 1 μm). The diffusion exchange of the W- and Ti-atoms and the formation of phase ranges were discussed. For the chemical diffusion coefficient, values of 2×10^{-10} cm²/s at 2300° C and 1.2×10^{-9} cm²/s at 2500° C were found. The activation energy was calculated to amount to 129 ± 15 kcal/mole. These data were utilized to interpret the reactions occurring during solid solution formation in cemented carbide alloys during the sintering process. (auth)

9368 EFFECT OF WB ON SOME PROPERTIES OF SINTERED WC-20 Co ALLOYS. Kase, K.; Miyashita, H.; Kaneko, A.; Nishimura, T.; Ishibashi, O. (Nippon Tungsten Co., Ltd., Fukuoka). Planseeber. Pulvermet.; 22: No. 2, 118-128(Jun 1974).

The effects of WB content on the physical and mechanical properties of WC–WB–Co alloys were investigated. It was found that the double boride of WCoB was most preferentially formed in WC, WB, and Co composition. Addition of WB lowered the sintering temperature of WC–20% Co; this effect was most marked in the alloys containing 2 and 5% WB. The hardness and coercive force of WC–WB–20% Co alloys containing up to 20% WB were increased almost in proportion to the WB content, which was mainly related to decrease of binder amount owing to the formation of WCoB. Water quenching, increased the hardness of the sintered alloys and the alloys containing up to 5% WB and more than 10% WB showed a remarkable improvement or deterioration in the transverse rupture strength. This effect may be attributed to the increase of tungsten amount dissolved in the binder phase of the alloys containing up to 5% WB and the formation of η phase in the alloys with more than 10% WB. In microstructure, the fine dispersed phase observed in the water quenched WC–WB–20% Co alloys may be assumed the boron rich borides, e.g. W_3CoB_6 or $W_2Co_{21}B_6$. (auth)

9369 STRUCTURE OF THE ENVIRONMENT AND BROADENING OF LUMINESCENCE LINES OF EUROPIUM IN GLASSLIKE MATRICES. Denisov, Yu.V.; Kovaleva, I.V.; Kolobkov, V.P.; Rastoskuev, V.V. Opt. Spectrosc. (USSR) 38: No. 1, 54-57 (Jan 1975).

Luminescence spectra of Eu^{3+} ions in fluoberyllate, silicate, phosphate, and germanate glasses are investigated. The field strengths acting on the europium ion are compared for oxygen-containing glasses and fluoberyllate glasses taking into account the nature of the symmetry of the Eu^{3+} ion environment. The uniform and nonuniform broadening in glasslike matrices with different ordering at room temperatures are studied in detail using the example of the resonance line of europium. The energy transfer probability over the same kinds of ions is determined in the absence of concentration quenching. (auth)

9370 THERMODYNAMIC PROPERTIES OF THE SYSTEM MOLYBDENUM–SILICON. Chart, T. G. Met. Sci.; 8: No. 10, 344-348(Oct 1974).

Gibbs energies of formation of Mo silicides were determined by the Knudsen-effusion vapor-pressure method between 1410 and 1675°K. Results were combined with data from the literature and the whole evaluated to give a set of self-consistent thermodynamic properties. The various inconsistencies between the data from the different investigations are discussed. (Metals Abstr.)

9371 AXIAL DISTRIBUTIONS OF ^{95}Nb AND ^{95}Zr ISOTOPES IN IRRADIATED UO_2–PuO_2 FUEL PINS. Phillips, J. R.; Netuschil, J. R.; Quintana, J. N.; Waterbury, G. R. (Los Alamos Scientific Lab., NM). J. Inorg. Nucl. Chem.; 37: No. 6, 1337-1340(Jun 1975).

Encapsulated UO_2–PuO_2 fuel pins irradiated in EBR-II were examined nondestructively using precision γ-scanning. ^{95}Nb had undergone significant axial migration depositing at specific axial locations, as well as migrating radially towards the central void regions. The ^{95}Zr precursor of ^{95}Nb appeared to have remained

with the fuel material, indicating that differences between the ^{95}Nb and the ^{95}Zr distributions were the result of the migration of only the niobium species. (auth)

Metals and Alloys

9372 (ORNL-TM-1100) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1965. Patriarca, P. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Jun 1965. Contract W-7405-eng-26. 108p. Dep. NTIS $8.50.

Activities in research programs are reported on fuel element development, nondestructive testing, solid state reactions, Zr metallurgy, and radiation effects on reactor structural materials. (JRD)

9373 (ORNL-TM-1270) FUELS AND MATERIALS DEVELOPMENT PROGRAM. Quarterly Progress Report for Period Ending September 30, 1965. Patriarca, P. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1965. Contract W-7405-eng-26. 152p. Dep. NTIS $10.75.

Activities are reported in research programs on precipitation in nuclear materials, fuel element development, nondestructive testing, Zr metallurgy, radiation effects on fuel materials, and radiation effects on reactor structural materials. (JRD)

9374 (ORNL-TM-1400) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1965. Patriarca, P. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Feb 1966. Contract W-7405-eng-26. 84p. Dep. NTIS $7.25.

Activities in research programs are reported on controlled precipitation in nuclear materials, fuel element development, mechanical properties of reactor materials, nondestructive testing, zirconium metallurgy, and radiation effects on fuel materials. (JRD)

Corrosion and Erosion

Refer also to abstract 8504.

9375 (KFK-2120) INFLUENCE OF COLD WORK ON STEAM CORROSION (550°, 70 at) OF FIVE FERRITIC STEELS WITH DIFFERENT CHROMIUM CONTENT. Leistikow, S.; Thenen, A. v.; Pott, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Feb 1975. 69p. (In German). Dep. NTIS (US Sales Only) $6.50.

Five different ferritic chromium steels were tested at 550°C and 70 atm in superheated steam to evaluate steam corrosion dependence on chromium content (0.8 to 18.7%) and the amount cold work (0 to 90%). Oxidation kinetics and oxide morphology were examined by gravimetric, metallographic, and microanalytical methods. The results showed that for all alloys (≥ 6.7% Cr) an increasing corrosion resistance with increasing cold work. A gain of 70 to 75% (related to the metal loss of the underformed material) was found after a 1000 hours exposure in case of 80% cold deformed alloys containing more than 11% Cr. The relationship between corrosion, chromium content, and cold deformation was approximated by a negative exponential function. Results of microanalysis showed high chromium content in local areas of highly deformed oxidized 18.7% Cr alloy. The effect of the bulk deforming pretreatments on corrosion rate is explained by improved diffusivity of chromium in the defect structure, preferential oxidation, and formation of a solid solution ($FeFe_{2-x}Cr_xO_4$) of spinel type as oxide subscale. Protective scales with low defect concentrations and reduced ion diffusivity were formed which are controlling the corrosion reaction. Thus, especially in case of highly deformed materials with medium chromium content the oxidation changed over from a parabolic to a logarithmic rate law. Experimental results showed that corrosion of ferritic steels with medium chromium content can be predicted if the chromium content as well as the cold deforming pretreatment are taken into account. (auth)

9376 (RD/B/N-2670) EFFECT OF HIGH CARBON ACTIVITY SODIUM UPON THE MECHANICAL PROPERTIES OF AISI 316 STAINLESS STEEL. Charnock, W.; Cordwell, J. E.; Gwyther, J. R.; Hobdell, M. R.; Marshall, P.; McLauchlin, I. R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1973. 38p. (CFR/SMWP/p-(73)81). Dep. NTIS (US Sales Only) $5.00.

Many mechanical properties tests have been performed upon specimens immersed in or pre-exposed to liquid sodium, but in general the sodium involved has been relatively poorly characterized. Results of experiments which apply recent advances in the determination of carbon activity in sodium, to the mechanical properties field are reported. The influence of pre-exposure to liquid sodium of controlled, known and high carbon activity upon the tensile, creep and fatigue behavior of AISI 316 stainless steel in subsequent air tests is described. Thin section specimens and highly carburizing conditions were chosen to examine extreme effects. In order to determine general trends in behavior, tensile, and fatigue properties were measured at room temperature and creep rates at 600°C. All specimens had a large ratio of carburized case/uncarburized core, which was found to cause a dramatic decrease in tensile ductility and a small reduction in ultimate tensile strength. Unusual behavior was observed in creep tests at 600°C. Creep rates were reduced relative to controls and periods of negative creep associated with carbide redistribution were observed. Ambient temperature fatigue tests demonstrated that carburization enhanced endurances at low stresses and reduced endurances at high stresses. Further work is required to permit extrapolation of the results to thicker section components, and to less severe conditions of exposure and mechanical loading. (auth)

9377 (SC-RR-69-791) SANDIA MATERIALS EVALUATION FOR COMPARATIVE STUDY OF MOLYBDENUM AND TANTALUM ALLOY CAPSULES. Ericksen, R. H.; Holland, J. R.; Johnson, D. R.; Mottern, D. J.; Van Den Avyle, J. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1969. 137p. Dep. NTIS $10.00.

A literature survey was conducted on tantalum and molybdenum base materials, and the relevant information is summarized and evaluated in this report. The results of various tantalum and molybdenum base materials tests conducted by Sandia and other AEC contractors were included in the survey. The results of tests of capsules based on tantalum and molybdenum alloy technologies also are summarized and evaluated. Topics covered include mechanical properties, oxidation, coatings, phase diagrams, compatibility, fabrication, and testing. (19 tables, 54 figures, 117 references) (DLC)

9378 HIGH-TEMPERATURE OXIDATION BEHAVIOR OF Ni ALLOYS WITH LOW Zr CONTENT. Ferrari, A.; Strocchi, P. M.; Riccardi, S. (CNR, Milan). Metall. Ital.; 66: No. 11, 595-600 (Nov 1974). (In Italian).

The high-temperature oxidation behavior of niobium-zirconium alloys with zirconium concentration up to 5% has been examined in the temperature range of 900 to 1400°C. The comparison between the activation energy of the oxidation process and the diffusion energy of oxygen in the niobium pentoxide and zirconium dioxide has confirmed that the oxygen is the migrating element; that it is thus the nature of the surface oxide to control the kinetics of the process. The oxidation rate coefficients have been correlated with the morphology of the oxidation products, identified as a function of temperature and zirconium content as allotropic forms of Nb_2O_5 α, α' and γ. The zirconium has an oxidation–rate reducing action which is clearly evident at temperatures above 1150°C; at lower temperatures instead a worsening has been observed. It has been seen that there is a sensible improvement at zirconium content up to 2%; however, from a practical point of view, the resistance to oxidation is still limited. (auth)

9379 FATIGUE-CRACK PROPAGATION IN A CAST STAINLESS STEEL. James, L. A. (Westinghouse Hanford Co., Richland, WA). Nucl. Technol.; 26: No. 1, 46-53(May 1975).

Linear-elastic fracture mechanics techniques were employed to characterize the crack growth behavior of SA-351 Grade CF8 cast stainless steel over the temperature range 75 to 1200°F. In general, crack growth rates increased with increasing test temperature. The crack growth rates in the cast material generally fell within or below the scatter bands for wrought Types 304 and 316 material tested under similar conditions, implying that data obtained on wrought material would likely yield conservative results for crack growth analyses on cast structures. (auth)

9380 OXIDATION BEHAVIOR OF W AND Mo SINGLE CRYSTALS IN THE PRESENCE OF A HIGH-ELECTRIC FIELD. Okuyama, F. (Nagoya Inst. of Tech., Japan). Jap. Appl. Phys.; No. Suppl. 2, 55-58(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The effects of negative high-electric fields of the order of 10^7–10^8 V/cm on oxidation of tungsten and molybdenum single crystals were investigated at 1200–1500 K for tungsten and at 900–1100 K for molybdenum, respectively, with the aid of a field emission and a transmission electron microscope. Oxidation of field emitters in the presence of a field resulted in the growth of crystallized oxides on the emitter surface, in different manners with tungsten and molybdenum. For tungsten, oxide crystals were constructed selectively on the {110} planes, whereas, for molybdenum, an oxide overlayer with a facetted structure was formed on the entire emitter surface. (auth)

9381 FIM OBSERVATION OF W TIPS CORRODED WITH DILUTE HNO_3. Morikawa, H.; Yashiro, Y. (Nagoya Inst. of Tech., Japan). Jap. Appl. Phys.; No. Suppl. 2, 67-70(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The initial stages of the corrosion process were observed for tungsten tips cleaned by field evaporation and then treated with dilute nitric acid. A large radius reduction of the tips was observed, and similar results were obtained for samples treated with distilled water and basic solutions. These samples, however, were only exposed to air for a few minutes between cleaning and treatment. If the tip was exposed to the air for more than a day before treatment with nitric acid, the corrosion was greatly reduced with only occasional pits being observed. (auth)

9382 EROSION, WEAR, AND INTERFACES WITH CORROSION. Seventy-sixth Annual Meeting of the American Society for Testing and Materials, Philadelphia, Pennsylvania, June 24-29, 1973. ASTM Special Technical Publication 567. Philadelphia; American Society for Testing and Materials (1974). 343p. (ASTM-STP-567; CONF-7306117-). $35.00.

Fifteen papers are included. Among the topics discussed are: finned heat exchanger tubes; cavitation erosion; cavitation-induced deformation of Al; rain erosion; influence of liquid properties on its erosive effects; damage; liquid impact behavior of nonmetallic materials; effects of velocity, impingement angle, heating, and aerodynamic shock layers on erosion at 5500 fps; effects of fatigue and dynamic recovery on rain erosion; wear of modified plasma-deposited Al bronze; erosion of fused silica by glass beads; and testing of brake lining materials. (DLC)

9383 PROCESS AND ELECTROLYTE FOR APPLYING BARRIER LAYER ANODIC COATINGS. Dosch, R. G.; Prevender, T. S. (to U. S. Atomic Energy Commission). US Patent 3,864,219. C23b9/02; C23b11/02. 4 Feb 1975. Filed date 8 Jan 1974. 5p.

PAT-APPL-431,818.

Various metals may be anodized, and preferably barrier anodized, by anodizing the metal in an electrolyte comprising quaternary ammonium compound having a complex metal anion in a solvent containing water and a polar, water soluble organic material. (auth)

9384 ELECTROCHEMICAL STUDY OF THE PITTING CORROSION OF AUSTENITIC CrNi STEELS CONTAINING FROM ABOUT 0 TO 4% Mo, WITH SPECIAL REGARD TO THE MEASURING ARRANGEMENT AND METHOD. Herbsleb, G.; Schwenk, W. (Mannesmann-Forschungsinstitut G.m.b.H., Duisburg (F. R. Germany)). Werkst. Korros.; 26: No. 1, 5-18(Jan 1975). (In German).

It is pointed out that the pitting potentials are not constants of a particular system, but depend only on the material and the corrosion medium; it is always necessary to take account of the potential influences emanating from the measuring system and the particular experimental method. With respect to comparative tests the potentiostatic determination of Usub(b) and the galvanostatic determination of Usub(p) are particularly useful. In the case of short time tests the galvanostatically determined value of Usub(p) yields a well defined limiting potential below which pitting occurs. This value, however, does not account for varying properties of Mo containing steels; in this case it is necessary to make potentiostatic experiments yielding inequivocal values of Usub(b) which cannot be obtained reliable when potentiodynamic tests are carried out. (auth)

Preparation and Fabrication

Refer also to abstracts 8613–8614, and 10838.

9385 (NLCO-1113) URANIUM DECONTAMINATION OF COMMON METALS BY SMELTING, A REVIEW (HANDBOOK). Mautz, E. W.; Briggs, G. G.; Shaw, W. E.; Cavendish, J. H. (comps.). (National Lead Co. of Ohio, Cincinnati (USA)). 5 Feb 1975. Contract AT(30-1)-1156. 42p. Dep. NTIS $5.25.

The published and unpublished literature relating to the smelting of common metals scrap contaminated with uranium-bearing compounds has been searched and reviewed. In general, standard smelting practice produces ingots having a low uranium content, particularly for ferrous, nickel, and copper metals or alloys. Aluminum recovered from uranium contaminated scrap shows some decontamination by smelting but the uranium content is not as low as for other metals. Due to the heterogeneous nature and origin of scrap metals contaminated with uranium, information is frequently missing as to the extent of the initial contamination and the degree of decontamination obtained. The uranium content of the final cast ingots is generally all that is available. Results are summarized below by the primary composition of the uranium contaminated scrap metal. (auth)

9386 (SLL-74-5011) JOINING BERYLLIUM BY PLATING. Dini, J. W.; Johnson, H. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 41p. (CONF-750626-1). Dep. NTIS $5.25.

From American Electroplaters' Society light metals symposium; Toronto, Canada (Jun 1975).

Results of quantitative adhesion tests indicate that an acid etch followed by a dilute zincate treatment should be used when plating on beryllium. Applications wherein beryllium was joined to itself or to stainless steel are presented. (auth)

9387 (Y-DA-5196) MOIRE TECHNIQUES FOR MEASURING STRAINS DURING WELDING. Johnson, L. D. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1972. Contract W-7405-eng-26. 23p. (CONF-730511-5) Dep. NTIS $4.25.

From 3rd international congress on experimental mechanics conference; Los Angeles, California, USA (14 May 1973).

The present work measures dynamic strains near welds using a projected-grating moire technique. Experimental procedures have been developed for producing the orthogonal submaster gratings and etched heat-resistant specimen gratings. A modification of the grid-analyzer method allows all strain information to be obtained from a single photograph. A mathematical procedure combines fringe patterns from small adjacent sections of a surface into a larger continuous pattern. Computerized regression techniques enable more rapid and accurate analysis of the data. Results from welds in an Al–Mg alloy show the feasibility of dynamic welding strain analysis using this approach. Welding deformation is found to be almost entirely shear straining, which explains the nature and orientation of high-temperature cracks sometimes found near welds. (auth)

9388 X-RAY FLUORESCENCE ANALYSIS OF THIN LAYERS AND DIFFUSION LAYERS ON SOME COPPER ALLOYS. Grimaldi, R.; Randi, G. (Laboratorio Centrale Italsider, Genoa). Metall. Ital.; 66: No. 11, 601-604(Nov 1974). (In Italian).

A method is described based on the x-ray fluorescence analysis of thin layers, and measurement of their thickness, as obtained by electrodeposition of metal elements on a copper support. The method developed works on the principle of fluorescence emissions by an element characterizing the layer or sublayer, operating a mathematical transformation of the general equations of the emission in order to obtain the results without using reference specimens. (auth)

9389 PRODUCTION AND CONDENSATION OF METAL VAPORS IN LARGE QUANTITIES. Reichelt, W. Angew. Chem. Int. Ed. Engl.; 14: No. 4, 218-222(Apr 1975).

Aspects of metal vapor condensation are considered. Discussions and data are included on binding energy and evaporation rates, electron-beam evaporation, sputter processes, condensation and cooling, and evaporation plants. (JRD)

9390 ALUMINOTHERMIC REDUCTION OF THE OXIDES OF TITANIUM AND ZIRCONIUM. Lalayan, M. S.; Elyutin, A. V.; Dubrovskii, A. Ya. Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst. Redkometal, Prom; No. 56, 23-31(1973). (In Russian)

The aluminothermic reduction of TiO_2 and ZrO_2 are considered. With TiO_2 the process requires at least $N_{Al} = 0.5$ [N = mole fraction], i.e. Al 36% to proceed. The extent of the reduction increases with higher Al contents reaching a maximum value of 90.5% with 170 to 200% Al in excess of stoichiometric proportions. In general, the reduction is less complete with ZrO_2 than with TiO_2 although the O concentration in the metal has a tendency to decrease as the Al content is increased, e.g. with Al 140% of stoichiometric amounts the O content falls from 1.4 to 0.4%. Higher quantities of Al have no further effect. (Metals Abstr.)

9391 CHEMISTRY AND THERMODYNAMICS OF THE LIQUID PHASE CARBOTHERMIC REDUCTION OF NIOBIUM. Berlin, I. K.; Vaisenberg, A. I.; Elyutin, A. V. Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst. Redkometal. Prom.; No. 56, 64-72(1973). (In Russian).

X-ray and metallographic studies were made of the intermediate products that occur in the liquid phase in the carbothermic reduction to Nb. Both the direct process, i.e. Nb_2O_5 and C, and the carbide process, i.e. Nb_2O_5 and carbide, are identical and take place by the same stepwise route. The process occurs only in the liquid phase in which Nb_2O_5, NbO_2, NbO, and eutectic mixtures of the Nb–C–O react. Calculations of free energies in the range 1700 to 3800 °K establish that the formation of these intermediates and Nb is possible in the melt up to the melting point of Nb. The most difficult stage is the reduction of NbO to Nb which begins at 2970 °K. (Metals Abstr.)

9392 ALUMINOTHERMIC REDUCTION OF VANADIUM PENTOXIDE. Elyutin, A. V.; Lalayan, M. S.; Gurevich, M. A. Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst. Redkometal. Prom.; No. 56, 12-22(1973). (In Russian).

The phase composition of the reaction products was studied to determine the mechanism of the Al reduction of V_2O_5. The mechanism proposed is: (i) fusion of the charge components (V_2O_5 and Al); (ii) the formation of a metal phase consisting of the lower oxides of V, i.e. VO, $VO_{0.7}$, and $VO_{0.18-0.28}$ (the proportion of these depends on the stoichiometric percentage of Al in the charge, which lies between 50 and 80%), and a slag phase composed of a solution of the lower oxides in αAl_2O_3. Al greater than in stoichiometric proportions forms a metal constituent of a solid solution of V–Al containing a small amount of oxide phase, and a slag phase of α-corundum with monoxide impurity. (Metals Abstr.)

9393 PURIFICATION OF IRIDIUM. Inouye, H. (to U.S. Atomic Energy Commission). US Patent 3,867,137. C22b11/02. 18 Feb 1975. Filed date 22 Jun 1973. 4p.

PAT-APPL-372,886.

A process is described for purifying iridium metal by oxidizing impure iridium metal to form volatile IrO_3, condensing the IrO_3 as IrO_2 and reducing the IrO_2 back to substantially pure iridium. (auth)

9394 TUNGSTEN SEAL COAT. Webb, J. E. US Patent 3,501,337. C23c13/02. 17 Mar 1970. Filed date 27 Dec 1966. 2p.

PAT-APPL-605,088.

A two-step process is described for cladding nuclear fuels with tungsten, comprising first vapor depositing a thin seal coat of tungsten onto the fuel element in an evacuated chamber under reaction conditions suitable for the application of such a thin coat. This is followed by the vapor deposition of a final heavier main outer coating of tungsten over the seal coating under conditions more suitable for such cladding. (auth)

9395 METHOD FOR PREPARING SUPERCONDUCTORS. Dahlgren, S. D. (to U. S. Energy Research and Development Administration). US Patent Application 528,382. Filed date 29 Nov 1974. 17p.

A superconductor having an equiaxed fine grain beta-tungsten crystalline structure found to have improved high field critical current densities is prepared by sputter-depositing superconductive material onto a substrate cooled to below 200°C and heat-treating the deposited material. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 8593, 9038, 9349, 9363, 9597, 10448, 10734, 10769, 10944, and 11042.

9396 (AERE-R-7934, pp 18-36) PRODUCTION OF DISPLACED ATOMS IN SOLIDS. Robinson, M. T. (Oak Ridge National Lab., TN). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The displacement doses and dose rates produced in solids by irradiation with various sorts of particles are usually estimated by a modification of the Kinchin-Pease model. The status of several ingredients of this model is surveyed, with a view to identifying areas where further research is important. Comparisons with available experimental data indicate the unsatisfactory nature of present theories of the electronic stopping of low velocity atomic recoils. Estimates of the damage energy may therefore be significantly in error. Computer simulations show that the assumed linear dependence of the number of displacements in a cascade on the damage energy is probably not correct in dense cascades. The details of cascade structure still require elucidation, particularly as they affect the nucleation and growth of voids, gas bubbles, dislocation loops, and the like. (auth)

9397 (BMFT-FB-T-74-34) INVESTIGATION FOR THE DEVELOPMENT OF A HIGH-TEMPERATURE Ni-BASE CAST SUPERALLOY WITH HIGH CREEP RESISTANCE AND GOOD STRUCTURAL STABILITY AT TEMPERATURES BETWEEN 900° AND 1,100°C. Schubert, F. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany); Zentralstelle fuer Luft- und Raumfahrtdokumentation und -information, Muenchen (F. R. Germany)). Nov 1974. 231p. (In German). INIS.

Test pieces of 16 experimental alloys (basic nominal composition in weight%: 0.12 C, 10 Co, 7 Cr, 13.5 W, 5.5 Al) with different contents of Ta, Ti, Nb, Hf, Mo and W were produced by vacuum investment casting. The data of tensile tests up to 1,100°C and creep and stress-rupture test (time-to-rupture up to 2,300 hrs) of specimens in cast and heat-treated condition are given. Microstructural examinations by optical and electron microscope and by electrochemical phase extraction on the tested and on overaged (1,000 h at temperature between 800° to 1,000°C) specimens allow the description of phase kinetics and creep controlling mechanisms. The creep behavior is governed by the stress-induced γ'-growth, which is responsible for the dislocation network, and by the reactions of phases and dislocation reactions in grain boundaries and interdendritic areas. The result of all the studies is a new high-temperature Ni-base cast Superalloy named FI S 145 (nominal composition in weight %: 0.13 C, 10 Co, 7.7 Cr, 13.7 W, 5.5 Al, 5.0 Ta + B, + Zr, + Hf) with creep rupture data better than the upper limit of the known conventional cast Superalloys. (auth)

9398 (CEA-CONF-2780) RELATIONSHIP BETWEEN THE CHANGE IN THE MICROSTRUCTURE AND THE RUPTURE MECHANISMS DURING CREEP TESTS CARRIED OUT ON A LOW CARBON ZCND 17/13 STEEL. Robert, G.; Silvent, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). 14 Jun 1974. 20p. (In French). INIS.

From 17th colloquium on metallurgy. Mechanical and metallurgical factors of rupture especially in nuclear industry; Saclay, France (24 Jun 1974).

A study was made of the microstructural change in a low carbon austenitic steel, ZCND 17-13, during creep tests carried out at 700 deg C. The analysis of this microstructure shows that carbon precipitation occurs in some grain boundaries and that a hyperstructure grows characterized by the heterogeneity of the size of the cells. Thus near the grain boundaries oriented parallel to the stresses and containing many carbide precipitates, the size of the sub-grains is smaller than in the remainder of the matrix. To correlate these experimental observations with the intergranular decohesions observed, a qualitative intergranular slip mechanism is suggested based on the existence of particular dislocations of grain boundaries. (FR)

9399 (CONF-731229-P16C) PROCEEDINGS OF THE NUCLEAR PHYSICS AND SOLID STATE PHYSICS SYMPOSIUM, BANGALORE, INDIA, DECEMBER 27–31, 1973. Volume 16 C Solid State Physics. (Department of Atomic Energy, Bombay (India)). 1973. 387p.

Subjects of papers presented at the conference included low temperature behavior of solids and liquids, and electronic, thermodynamic, and magnetic properties of solids. Fifteen of the papers were in subject scope of NSA. (SFL)

For abstracts of individual papers see: 9337, 9434–9441, 9601, 10018–10020, 10444, and 10454.

9400 (CONF-750617-1) ELEVATED TEMPERATURE FATIGUE BEHAVIOR OF 2¼ Cr-1 Mo STEEL. Brinkman, C. R.; Booker, M. K.; Strizak, J. P.; Corwin, W. R. (Oak Ridge National Lab., Tenn. (USA)). 1975. 26p. Dep. NTIS $4.50.

From second ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

Results are reported for a number of load and strain controlled fatigue tests conducted over the temperature range of room temperature to 1000°F. Cyclic hardening and softening characteristics for a single heat of 2¼ Cr-1 Mo steel in the isothermally annealed condition are discussed. Comparisons of the data generated in this effort are made with data available from the literature and from these compilations ASME design fatigue curves were prepared covering continuous high and low cycle behavior over the temperature range of room temperature to 1100°F. Equations for these design curves are also given. (auth)

9401 (CONF-750617-5) APPENDIX. Material Property Data for Elastic-Plastic-Creep Analysis of Benchmark Problems. Corum, J. M. (Oak Ridge National Lab., Tenn. (USA)). 1975. 16p. Dep. NTIS $4.00.

From second ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

A summary is presented of the applicable material property data required as input to conventional elastic-plastic and elastic-plastic-creep analyses of the experimental benchmark problems described in the first six papers. These data were used in the exemplary inelastic analyses presented in the seventh paper. The data provided include elastic constants and a monotonic stress-strain curve at room temperature; elastic constants, cyclic stress-strain curves, and physical properties for the 800 to 1100°F temperature range, and uniaxial, constant-stress creep data for a temperature of 1100°F. (auth)

9402 (INR-P-1460/2/PS/C) THE FOURIER ANALYSIS OF MAGNETIC FORM FACTORS OF SOME 3d FCC ALLOYS. Dobrzynski, L. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 48p. INIS.

The Fourier analysis of magnetic form factors of 3d metals

and alloys is discussed. It is shown that this kind of analysis may be carried out in a self-consistent manner and is especially interesting when applied to the case of alloys. From the measured form factor of an alloy the spin form factor can be obtained and then compared with the spin form factors of the alloy constituents. In this way the possibility of representing the alloy form factor by a simple average of the form factors of alloy components is checked. The analysis carried out for Ni–Co, Ni–Fe and Co–Fe alloys shows that the e_g-type of magnetic moment increases linearly with the 3d-spin moment. The empirical formula for this dependence ($\mu(e_g) = -0.194 + 0.571\mu_{3d}$spin) reproduces well the asphericity of pure fcc Co, while the e_g moment obtained from it for Ni is much higher than observed experimentally. This indicates that the asphericity of nickel in the alloys considered is higher than the asphericity of pure nickel. In all the cases studied one has to introduce some delocalised moment into the analysis. Except for Ni–V, these moments are negative and their absolute values are usually smaller than obtained in the conventional way of analysis. The comparison of spin form factors of Ni–Co, Ni–Fe and Ni–V alloys with the spin form factors of the alloy constituents indicates that the nickel form factor is different from that one of pure nickel. The effect is especially pronounced for Ni–V alloy. (auth)

9403 (IS-RIC-7) SELECTED CERIUM PHASE DIAGRAMS. Gschneidner, K. A. Jr.; Verkade, M. E. (Iowa State Univ. of Science and Technology, Ames (USA). Rare-Earth Information Center). Sep 1974. 51p. Dep. NTIS $5.75.

A compilation of cerium alloy phase equilibria data based on the most reliable information available is presented. The binary systems selected are those of cerium with each of the following twenty-nine elements which might be commonly found in steels: Al, Sb, As, Bi, Ca, C, Cr, Co, Nb, Cu, Fe, Pb, Mg, Mn, Mo, Ni, N, O, P, Se, Si, Ag, S, Te, Sn, Ti, W, and Zn. A brief discussion, a summary of crystal lattice parameters where applicable, and a list of references is included for each element surveyed. (auth)

9404 (JUL-1167) MOESSBAUER EFFECT OF ^{119}Sn IN AMORPHOUS SUPERCONDUCTING METALS. Bolz, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Feb 1975. 75p. (In German). Dep. NTIS (US Sales Only) $6.75.

Thesis.

Measurements of the Moessbauer effect of ^{119}Sn in crystalline and disordered Sn and in crystalline and amorphous $Sn_{1-x}Cu_x$ ($0 \leq x \leq 0.3$) in the temperature range $2.6 < T < 110$ K are reported. The samples were prepared by condensing the vapor onto a cold substrate. From the measured Debye–Waller factors it is concluded that the observed changes in the Eliashberg function $\alpha^2(\omega)F(\omega)$, and therefore the superconducting properties, cannot be explained by changes in the phonon spectrum. The observed isomeric shifts show that the covalent bonds present in the crystalline substances are destroyed in the amorphous state. The superconducting and electronic properties of amorphous Sn(Cu) are similar to the high pressure phase of Sn. (auth)

9405 (KFK-2112) CREEP AND CREEP-RUPTURE BEHAVIOUR OF THE AUSTENITIC STAINLESS STEEL X8 CrNiMoVNb 1613 AT CONSTANT AND VARYING TEMPERATURES. Closs, K. D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jan 1975. 109p. (In German). Dep. NTIS (US Sales Only) $8.50.

The creep and creep-rupture behavior of tubes made from the austenitic stainless steel X8 CrNiMoVNb 1613 (German steel number 1.4988) was investigated at constant and varying temperatures. By analyzing the stress distribution within the wall of a pressurized tube it is shown that the characteristic stresses and deformations can be found at the skeletal point. The creep behavior at constant temperatures is then analyzed. Formulas are derived which describe the creep and creep-rupture behavior of this material in the temperature range from 650 to 700°C and for stresses between 6 and 23 kgf/mm^2. These formulas are then used for calculating the creep behavior under varying temperatures. A comparsion with the experimental results shows that in some cases large deviations occur between calculated and experimental results. An increase in creep rate due to temperature cycling is sometimes observed. This abnormal creep behavior is attributed to the complex precipitation behavior of this alloy. (auth)

9406 (LFEN-164) STRUCTURAL TRANSFORMATION DURING THE AGEING OF MARAGING ALLOYS OF THE Fe–Cr–Co–Mo SYSTEM. Correia, R. N. (Junta de Energia Nuclear, Sacavem (Portugal). Lab. de Fisica e Engenharia Nucleares). 1974. 14p. (In Portuguese). INIS.

2 figs., 3 tables.

A review of the structural transformations which take place during the ageing of maraging alloys of the Fe–Cr–Co–Mo system is presented in this issue. Reference is made to the mechanisms which have been considered as accounting for the hardening of such alloys. The processes likely to determine the effect of simultaneous additions of cobalt and molybdenum are discussed. (INIS)

9407 (N-74-34046) INTERDIFFUSION BEHAVIOR OF TUNGSTEN OR RHENIUM AND GROUP V AND VI ELEMENTS AND ALLOYS OF THE PERIODIC TABLE. Part 1. Final Report. Arcella, F. G. (Westinghouse Electric Corp.; Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1974. Contract NAS3-13231. 245p. (NASA-CR-134490; WANL-M-FR-74-005-Pt-1). NTIS $15.25.

Arc cast W chemical vapor deposition (CVD)W, CVD Re, and powder metallurgy Re materials were hot isostatically pressure welded to ten different refractory metals and alloys (Nb, Nb-1 Zr, Ta, Ta–10 W, T-111, ASTAR-811C, W-25 Re, Mo–50 Re, and W–30 Re–20 Mo) and thermally aged at 10 to the minus 8th power torr at 1200, 1500, 1630, 1800, and 2000°C for 100 to 2000 hr. Electron beam microprobe analysis was used to characterize the interdiffusion zone width of each couple system as a function of age time and temperature. Extrapolations of interdiffusion zone thickness to 10,000 hr were made. Classic interdiffusion analysis was performed for several of the systems by Boltzmann-Matano analysis. A method of inhibiting Kirkendall voids from forming during thermal aging of dissimilar metal junctions was devised and experimentally demonstrated. An electron beam weld study of Nb–1 Zr to Re and W–25 Re demonstrated the limited acceptability of these welds. (STAR)

9408 (N-74-34939) STRESS-RUPTURE STRENGTH AND MICROSTRUCTURAL STABILITY OF TUNGSTEN–HAFNIUM–CARBON-WIRE REINFORCED SUPERALLOY COMPOSITES. Petrasek, D. W.; Signorelli, R. A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Oct 1974. 39p. (NASA-TN-D-7773; E-7931). NTIS $3.25.

Tungsten–hafnium–carbon superalloy composites were found to be potentially useful for turbine blade applications on the basis of stress-rupture strength. The 100- and 1000-h rupture strengths calculated for 70 vol percent fiber composites based on test data at 1090°C were 420 and 280 MN/m2, respectively. Results of the investigation indicated that with better quality fibers, composites having 100- and 1000-h rupture strengths of 570 and 370 MN/m2, respectively, may be obtained. Results of metallographic studies indicated sufficient fiber-matrix compatibility for 1000 h or more at 1090°C. (STAR)

9409 (ORNL-5045) MATANO: A COMPUTER CODE FOR THE ANALYSIS OF INTERDIFFUSION AND INTRINSIC DIFFUSION INFORMATION IN BINARY SYSTEMS. Carlson, P. T. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 189p. Dep. NTIS $7.60.

MATANO is a FORTRAN IV Computer Program written for use on the IBM 360/75 and 360/91 systems that determines interdiffusion and intrinsic diffusion coefficients from the experimental concentration-penetration profiles of infinite and semi-infinite diffusion couples. The flexibility of the code enables the user to deduce experimental values of diffusion coefficients as well as to calculate expected values for any given system. The fundamental input array consists of the experimentally determined x-ray intensity-penetration data obtained from electron microprobe analysis of the diffused couples, which the program subsequently converts to concentration-penetration profiles by comparison with standards of known composition. An analytical expression describing the concentration of each species as a function of penetration is then determined by fitting low-order polynomial splines to the experimental data by the method of least squares. Subsequent calculations are performed on the regenerated profiles. The extensive output of the program provides the user with a rapid summary of the experimental and calculated information in tabular as well as graphical formats. Although MATANO was written with the assumption of constant molar volume across the diffusion zone, a correction can be made for molar volume changes due to composition differences by substitution of lattice spacings for diffusion distances, if this information is available. (auth)

9410 (ORNL-SUB-3599-3) MULTIAXIAL CREEP BEHAVIOR OF 304 STAINLESS STEEL. Annual Report No. 3. Findley, W. N.; Mark, R. (Brown Univ., Providence, R. I. (USA). Div. of Engineering). Nov 1974. 49p. (EMRL-62). Dep. NTIS $5.50.

For Oak Ridge National Lab., TN.

Tests in combined tension and torsion, pure tension, and pure torsion were conducted at elevated temperatures (about 1100°F) for times ranging from 2.0 hours to 1008.7 hours on 304 stainless steel. Additional tests performed after the long-time creep tests are described. Attempts to measure circumferential strains were

continued. The best fit of the long-time creep and recovery data to the equation epsilon/sub ij/ equals epsilon/sup 0//sub ij/ + epsilon/sub ij/ + t/sup n/sub ij// was obtained by means of a least squares method. This equation was found to describe the data satisfactorily when the creep strains were small, i.e., (epsilon/sub ij/ − epsilon/sup 0//sub ij/) less than about 0.5 to 2.0 per cent. (auth)

9411 (ORNL-SUB-3649-3) EFFECT OF BIAXIALITY IN CREEP-FATIGUE AT ELEVATED TEMPERATURES. Annual Report, January 1, 1974–December 31, 1974. Zamrik, S. Y. (Pennsylvania State Univ., University Park (USA). Dept. of Engineering Mechanics). Mar 1975. 34p. Dep. NTIS $4.75.

For Oak Ridge National Lab., TN.

The effect of biaxiality in creep-fatigue interaction at elevated temperature is being investigated. Biaxial fatigue tests were conducted with thin-walled tubular specimens loaded with axial tension-compression and torsion. Biaxial strains were imposed under synchronous loading condition at 25 cycles per minute. Specimens were obtained from extruded 304 stainless steel rods, machined to specifications and annealed in an argon atmosphere at 2000°F. The experimental data covers uniaxial and biaxial fatigue tests at 1000°F and uniaxial and biaxial cumulative fatigue damage tests under a high to low loading sequence at 1000 and 1200°F. (auth)

9412 (ORNL-TM-4915) LAVES PHASES OF URANIUM AND TRANSITION METALS. Beahm, E. C. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 43p. Dep. NTIS $5.25.

Pauling's valence-bond theory of metals was used to calculate bond numbers of uranium-transition metal Laves phase compounds. Hybridization was determined from Pauling's relationships between single bond radii and d orbital participation in bonding. The assumption was made that the elements in a Laves phase compound hybridize, within limits, to the extent necessary to form that compound. According to this assumption, in any given Laves phase compound the components will have orbital hybridization and, thus, single bond radii characteristic of that compound. The absence of Laves phases in some systems, especially uranium–chromium, was explained by an inability to hybridize to the extent necessary for compound formation. These calculations enabled the prediction and experimental detection of Laves phases in the U-(Cr,Fe) system. UCrFe was observed as a C15 cubic Laves phase compound. (auth)

9413 (ORNL-tr-2980) RELATION BETWEEN THE SHAPE OF HIGH FREQUENCY HEATING COIL AND THE TEMPERATURE DISTRIBUTION IN SPECIMEN DURING THERMAL FATIGUE TEST. Maruyama, T.; Kimura, S.; Kurumaji, T. Translated by H. Kubota from Zairyo; 24: No. 258, 185-233(1975). 11p. Dep. NTIS $4.00.

The high frequency heating apparatus used for thermal fatigue tests, the relation between the shape of heating coils, and the temperature distribution of specimens was experimentally examined for SUS 304 stainless steel. Relations between heating coil dimensions and heating rate, the most ideal coil shape for various specimen types, and the effects of temperature range and specimen shape on temperature distribution are described. Results show that the heating rate increases with decreasing distance from specimen surface to heating coil and with increasing coil tube diameter. For the general cylindrical and hour glass type specimens, the most ideal coil shapes are a separate type and a parallel type coil, respectively, as judged from the point of temperature distribution. (auth)

9414 (ORNL-tr-2981) EFFECT OF TEMPERATURE ON THE RATE OF FATIGUE CRACK PROPAGATION IN SOME STEELS DURING LOW CYCLE FATIGUE. Taira, S.; Fujino, M.; Maruyama, S. Translated by H. Kubota from Zairyo; 24: No. 258, 227-233(1975). 11p. Dep. NTIS $4.00.

Temperature dependence of the rate of fatigue crack propagation in steels was examined, and compared with the temperature dependence of tensile ductility. Microcracks initiate and affect the propagation behavior of the main crack at elevated temperatures. Factors found to be elucidated include initiation rate of microcracks, reduction of ductility of the material in the vicinity of the main crack tip, and relaxation of concentrated strain by multicracks. It was found that during a strain controlled low cycle fatigue test at 1 cpm, the rate of crack propagation is largest at the blue-brittleness temperature range (200 to 300°C) in a low carbon steel. On the other hand, it is largest at above 700°C in austenite stainless steels. The temperature dependence of the rate of fatigue crack propagation is opposite to that of tensile ductility. Microcracks formed in the vicinity of the main crack tip were calculated, by considering the strain concentration and strain cycles imposed. Then, the local fracture strain were evaluated. Good correlation was found between the rate of crack propagation and the local fracture strain. (auth)

9415 (RDT-M-3-11T(5-75)) CARBON AND LOW ALLOY STEEL WELDED PIPE (ASME SA-155 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). May 1975. 10p. RSO.

A standard prescribing requirements for carbon and low alloy steel welded pipe (ASME SA-155 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 3-11T, dated November 1973. (JRD)

9416 (RDT-M-7-6T(5-75)) PRECIPITATION-HARDENING STAINLESS STEEL BARS, SHAPES, AND FORGINGS (ASME SA-564 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). May 1975. 11p. RSO.

A standard prescribing requirements for precipitation-hardening stainless steel bars, shapes, and forgings (ASME SA-564 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 7-6T, dated January 1974. (JRD)

9417 (UCRL-51774) FRACTURE-TOUGHNESS TESTS ON A HIGH-STRENGTH BERYLLIUM FROM ROOM TEMPERATURE TO 300°C. Perra, M.; Finnie, I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Mar 1975. Contract W-7405-eng-48. 29p. Dep. NTIS $4.00.

The temperature dependence of the fracture toughness of a high-yield-strength grade of hot-pressed beryllium block was determined between room temperature and 300°C. Fatigue cracks were generated in 8.92-mm-thick double-cantilever beam specimens by a reversed-loading method. Room-temperature fracture-toughness data from tests on specimens with Elox-machined notches and fatigue precracks were compared. Electron fractographs of fatigue and fast-fracture regions were obtained. Load-displacement records generated from tests on specimens with natural cracks were nonlinear, whereas tests on specimens with machined cracks gave the expected linear records. Evidence points to a crack-closure phenomenon rather than plasticity as the source of the nonlinearity. The fracture-toughness data indicate that for this material the mean value of the toughness increases from 9.0 MPa . m/sup ½/ (8.1 ksi . in/sup ½/) to 10.8 MPa . m/sup ½/ (9.7 ksi . in/sup ½/) between 23 and 300°C. (auth)

9418 (WARD-NA-3045-24) SODIUM TECHNOLOGY PROGRAM: FRICTION, WEAR, AND SELF-WELDING. Quarterly Progress Report for Period Ending January 31, 1975. Ray, W. E. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). May 1975. Contract E(11-1)-3045. 56p. AT.

Activities in research programs are reported on friction and wear of reactor materials in liquid Na, self-welding of reactor materials in liquid Na, and compatibility of low-friction materials in liquid Na. (JRD)

9419 EFFECTS OF Co, Va, AND C ON THE ANNEALING STRUCTURES OF SOME HIGH-SPEED STEELS. Paganini, L.; Bulckaen, V.; Baronti, R. Metall. Ital.; 66: No. 11, 617-621 (Nov 1974). (In Italian).

A comparison was made among three types of high-speed steels to stress the effects of a given alloy element on the annealing structures. One of these steels has been taken as a reference, the second one was alloyed with 5% Co and the third one had a higher V and C content. Each steel was originally quenched or hyperquenched at −100°C. The tests have been performed using both x-rays and electronmicroscopy techniques on replica and only partially by transparency. Moreover, the carbides have been extracted. In this way the percentage of the residual austenite, before and after the annealing treatment, and the quality, quantity, and morphology of the carbides were determined. It has been ascertained that adding Co and V causes membrane-like VC carbides to appear during the permanence at 560°C in the quenching process. In the first and third types of steel, as-quenched, some relatively fine and spherical carbides were singled out which are probably VC and do not appear in the second type of steel. (auth)

9420 INVESTIGATION OF INTERACTION OF INTERMETALLIDES Nb(Ta)Pt_2 WITH LAVES PHASES IN THE Nb(Ta)−Co SYSTEMS. Statnova, E. A.; Kuprina, V. V.; Sokolovskaya, E. M. Vestn. Mosk. Univ., Ser. II. Khim.; 16: No. 1, 115-116(1975). (In Russian).

New triple compounds were found under interaction of intermetallide $NbPt_2$($TaPt_2$) with Laves phase $NbCo_2$($TaCo_2$). (auth)

9421 PRESSURE DEPENDENCE OF THE STRUCTURE FACTORS OF LIQUID ALKALI METALS. Tsuji, K. (Kyoto Univ.); Endo, H.; Minomura, S. Phil. Mag.; 31: No. 2, 441-452(Feb 1975).

Measurements were made of X-ray diffraction by liquid Na, K, and Ca under pressures up to 4 kbar at various temperatures.

There are large differences between these three metals in the extent to which the structure factor a(K) changes with pressure. The volume dependences of a(K) are discussed on the basis of various hard-sphere models. It is found that the fixed packing fraction model is appropriate for liquid Na and K along the melting curve. The triplet correlation functions are also discussed. The pressure dependences of the electrical resistivities of liquid Na and K are calculated using the experimental results for a(K) under pressure, on the basis of a nearly free electron model. (auth)

9422 PARAMETERS AFFECTING CRITICAL CURRENTS IN SUPERCONDUCTING Nb_3Al. Martin, P. J.; Campbell, A. M.; Evetts, J. E. (Cambridge Univ., Eng.). J. Mater. Sci.; 10: No. 3, 498-504(Mar 1975).

Alternating current susceptibility measurements made on samples of Nb_3Al have shown that, even after extensive heat-treatments, significant amounts of degraded A15 phases are present. This low critical field material, resulting from vacancies on the niobium chains, limits the current carrying capacity of the bulk sample. The indication is that under favorable conditions the critical current density of Nb_3Al could equal or be superior to that of Nb_3Sn. (auth)

9423 ELECTROMAGNETIC DETECTION OF ULTRASONIC SHEAR WAVES IN SUPERCONDUCTING TIN. Thomas, R. L.; Lea, M. J.; Sendezera, E.; Dobbs, E. R. (Bedford Coll., London). J. Phys., F (London); 5: No. 3, L21-L25(Mar 1975).

Ultrasonic shear waves have been detected electromagnetically at 15.3 MHz in a single crystal of pure tin between 1.5 and 4.2°K in zero magnetic field. The radiation efficiency H(T) decreases rapidly below the superconducting transition temperature. The temperature dependence of H(T) for an electropolished surface is in good agreement with that calculated from the change in the complex conductivity $\sigma(q,\omega)$. From the data a London penetration depth $\lambda_L(0) = 253 \pm 25$ Å for a (001) surface has been obtained. (auth)

9424 ELECTRON SPIN RESONANCE IN $LaNi_5$-Gd ALLOYS: ABSENCE OF DYNAMIC EFFECTS IN THE BOTTLENECK. Male, S. E.; Taylor, R. H. (Imperial Coll. of Science and Tech., London). J. Phys., F (London); 5: No. 3, L26-L30(Mar 1975).

The linewidth and g-shift as a function of temperature have been studied for various concentrations of $Gd(4f^7)$ in the intermetallic compound $LaNi_5$. Both parameters show a strong temperature dependence which has previously been ascribed to dynamic effects in the electron spin resonance bottleneck. It is shown that this temperature dependence can be better explained by considering the effects of magnetic ordering in the compounds. (auth)

9425 HALL COEFFICIENT OF BERYLLIUM. Shiozaki, I. (Yokyo Metropolitan Univ.). J. Phys., F (London); 5: No. 3, 451-458(Mar 1975).

In order to explain the remarkable anisotropy and large absolute values of the Hall coefficients of beryllium, the contributions from the several parts of the Fermi surface are estimated. A calculation of the Hall coefficients is performed with a simplified model of the Fermi surface which is constructed on the basis of the de Haas-van Alphen data of beryllium. Results agree well with the experimental values. It is found that the large absolute values of R(H)(parallel) and R(H)(perpendicular) are due to light electrons and light holes respectively. (auth)

9426 MAGNETIC PROPERTIES OF $LaCo_{5x}Ni_{5-5x}$. Brouha, M.; Buschow, K. H. J. (Philips Gloeilampenfabrieken N. V., Eindhoven, Netherlands). J. Phys., F (London); 5: No. 3, 543-554(Mar 1975).

The magnetic properties, the pressure dependence of the Curie temperature (T_c), and the initial compressibilities of the series of compounds $LaCo_{5x}Ni_{5-x}$ were determined. The compounds with $x \geq 0.6$ are ferromagnets while for the compounds with $0.2 < x < 0.6$ the ferromagnetic order is not stable at all temperatures below T_c. For these compounds a magnetic phase transition is observed near 25°K, below which temperature the magnetization almost completely disappears. For the ferromagnetic phase the observed variation with x of T_c, $d\ln T_c/d\ln V$ and the moment per formula unit were analyzed in terms of the collective electron model. Both the density of states at the Fermi surface and the effective interaction between the d electrons are strongly affected upon replacement of Co by Ni. (auth)

9427 CALCULATION OF SPECTRA OF SOLIDS: CONDUCTION ELECTRON SUSCEPTIBILITY OF Gd, Tb, AND Dy. Lindgaard, P. A. (Danish Atomic Energy Commission, Risoe). Solid State Commun.; 16: No. 5, 481-484(1 Mar 1975).

The Gilat-Raubenheimer method simplified to tetrahedron division is used to calculate the real and imaginary part of the dynamical response function for electrons. A frequency expansion for the real part is discussed. The Lindhard function is calculated as a test for numerical accuracy. The conduction electron susceptibility is calculated for Gd, Tb, and Dy using the RAPW energy bands by Keeton and Louks (Phys. Rev.; 168: 672 (1968)). (auth)

9428 T^5 LAW AND MATTHIESSEN'S RULE. Bressan, O. J.; Ridner, A. E.; de la Cruz, F. (Comision Nacional de Energia Atomica, San Carlosde Bariloche, Argentina). J. Phys., F (London); 5: No. 3, 481-486(Mar 1975).

Precise electrical resistivity measurements on very dilute nonmagnetic indium alloys show no doubt in a T^5 dependence on temperature between 1 to 4°K and strong deviations from Matthiessen rule. Measurements of thermal resistivity show that the extrapolation method to obtain the data to $H = 0$ is correct. Comparison of the results with recent theories is discussed. (auth)

9429 GIANT KONDO RESISTIVITY IN (La, Ce)B_6. Winzer, K. (Univ., Goettingen, Ger.). Solid State Commun.; 16: No. 5, 521-524(1 Mar 1975).

The electrical resistivity of the system (La,Ce)B_6 was measured in the temperature range 0.04 to 300°K. The alloys show a Kondo minimum at about 20°K and a strong increase of the resistivity with decreasing temperature. The low temperature increase of the resistivity due to the Kondo effect of a sample containing 1.20 at.% Ce is about half as large as the room temperature resistivity of LaB_6. The Kondo temperature T_K of (La, Ce)B_6 was found to be 1.1 ± 0.2°K by comparison of the experimental results with theoretical predictions of the resistance anomaly associated with the formation of the spin-compensated state. (auth)

9430 COMPRESSION OF LANTHANUM TO 120 KBAR. Syassen, K.; Holzapfel, W. B. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart). Solid State Commun.; 16: No. 5, 533-536(1 Mar 1975).

Lanthanum is studied by high pressure X-ray diffraction. The equation of state of the fcc phase is determined at room temperature up to 120 kbar. The variation of the bulk modulus is compared with respective data of other rare earth elements. (auth)

9431 SUPERCONDUCTIVITY OF AMORPHOUS INDIUM WITH SILVER IMPURITIES. Granqvist, C. G. (Chalmers Tekniska Hoegskola, Goteborg). Solid State Commun.; 16: No. 5, 581-584(1 Mar 1975).

Amorphous, vapor quenched films of $In_{0.88}Ag_{0.12}$ were investigated. Depressions of the superconducting transition temperatures and energy gaps were proportional to inverse film thickness. The phonon induced tunneling structure displayed one pronounced dip in analogy with amorphous tin. The resistivity changed in a step-like manner upon annealing. (auth)

9432 METHOD OF TREATING Ti–Nb–Zr–Ta SUPERCONDUCTING ALLOYS. Horiuchi, T.; Monju, Y.; Tatara, I.; Nagai, N.; Hisata, M.; Matsumoto, K. (to Kobe Steel, Ltd.). US Patent 3,867,209. 18 Feb 1975. Filed data 17 Sep 1973. 10p.

A superconducting alloy is formulated from 10 to 50 at. percent Ti, 20 to 50 at. percent Nb, 10 to 40 at. percent Zr, and 5 to 12 at. percent Ta. A Ti–Nb–Zr–Ta superconducting alloy with a fine, non-homogeneous structure is obtained by forming a beta solid solution of Ti–Nb–Zr–Ta alloy by heating to a temperature within the beta solid solution range, cooling and then cold working the heated alloy. The cold worked alloy is heated to a temperature within the (beta' + beta'') alloy to maintain the peritectoid structure, cold worked, then heated to a temperature within the eutectoid range to form a multiphase alloy structure and then cooled, and finally cold worked. (Official Gazette)

9433 SUPERCONDUCTIVITY IN Pb–PbTe THIN FILM STRUCTURES. Johnson, A. C.; Jones, M. E.; Herman, A. M; Deck, R. J. (Tulane Univ., New Orleans). Solid State Commun.; 16: No. 6, 803-806(15 Mar 1975).

The critical temperatures of thin superconducting films of Pb in intimate contact with PbTe have been measured resistively. The films were formed by sequential deposition and by co-evaporation of Pb and PbTe. The results show a depression of the critical temperature. (auth))

9434 MAGNETO-THERMAL EFFECTS IN THE MIXED STATE OF TYPE II SUPERCONDUCTORS (Nb, Nb–W, Nb–Ti, Nb–Mo). Subramanyam, S. V. (Indian Inst. of Science, Bangalore); Chopra, V. pp 1-3 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

Magneto-thermal effects were studied in single crystals of Nb and Nb doped with W, Ti, and Mo as a function of temperature and field sweep rate. Flux jumps were recorded, and fields at

which the temperature reaches a maximum were studied. Effects of a small heat sink were also studied. (DLC)

9435 ELECTRON ENERGY LEVELS IN CRYSTALLINE LATTICE AND ORIGIN OF SOME SATELLITES OF METALLIC Cd. Rai, S. (Univ. of Allahabad, India). pp 30-33 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

Hayasi's model of allowed electron energy levels (QSS) seems to be adequate in explaining the origin of the L satellites, in the x-ray region considered, when accurately determined parent line is taken into account. However, their correlation with corresponding absorption maxima assumes a new shape. This investigation not only provides some positive evidence for the existence of electron energy levels (QSS) in lattices of metallic cadmium but will also prove to be of great value in considering the general validity of Hayasi's model of the origin of hf satellites in the x-ray region. (auth)

9436 LORENZ NUMBER IN Pd-W ALLOYS AT HIGH TEMPERATURES. Reddy, B. K. (Indian Inst. of Tech., Delhi); Jain, S. C.; Chari, M. S. R.; Natarajan, N. S.; Goel, T. C. pp 79-81 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

Electrical and thermal conductivities of three Pd-W alloys (10, 15, and 20% W) were measured and the electronic Lorenz numbers L_e compared with predictions from Kolomoets' theory. At 1200°K, L_e is 4.5, 6.3, and $7.0 \times 10^{-8} V^2K^{-2}$, and the lattice thermal conductivity is 17.5, 11.0, and 8.0 $Wm^{-1}K^{-1}$ for increasing W content. (DLC)

9437 ANGULAR CORRELATION OF ANNIHILATION RADIATION IN NIOBIUM. Sharma, B. K. (Univ. of Rajasthan, Jaipur, India). pp 94-96 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

For experimental angular distribution curves where the distinction between the annihilation of conduction electrons and core electrons is not clear, a computation of the core electron annihilation angular distribution is necessary. Such a computation was made for polycrystal niobium, ignoring the effects of electron-positron correlation. Results for the positron wave function and angular correlation curves are shown, and theoretical and experimental results are compared. (PMA)

9438 STRUCTURE OF X-RAY K-ABSORPTION OF Y AND Co IN YCo_3. Bhat, N. V. (Univ. of Bombay). pp 114-116 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

The x-ray K-absorption spectra were studied for the intermetallic compound YCo_3, a 3d-transition metal with a 4d-transition metal. An attempt was made to correlate the observed changes with the band structure (available empty states). Both absorption curves shifted to the low energy side, Co by 2.5 eV, and Y by 1.9 eV. The results indicate that the Fermi energy shifts to the low energy side and that the rigid-band model may still be applicable to this compound. (auth)

9439 SATURATION MAGNETIC MOMENT OF Sm IN FERROMAGNETIC Sm COMPOUNDS. Malik, S. K. (Tata Inst. of Fundamental Research, Bombay). pp 280-283 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

The saturation magnetic moments are calculated as a function of the crystal potential strength coefficients for a cubic samarium ferromagnet. The Sm ions occupy a site of cubic symmetry, and the [100] direction is assumed to be the direction of easy magnetization. The results are correlated with experimental data for Sm compounds. (auth)

9440 RKKY INTERACTIONS IN $GdAl_2$ HAVING THE EMBEDDED IMPURITIES OF Y AND La. Bajaj, M. M.; Mahanwal, J. S. (Univ. of Delhi). pp 373-375 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

The RKKY Model was used in an investigation of the Laves phase intermetallic compound $GdAl_2$ having Y and La dopings. The expression for the Knight shift was correlated with NMR spin echo spectra, and the shift in the g value was found to be on the order of 10^{-7}. The effects of impurities on the maxima of the spin echo spectra are shown graphically. (auth)

9441 ISOTROPIC KNIGHT SHIFT OF CADMIUM. Gupta, A. (Saha Inst. of Nuclear Physics, Calcutta); Kumar, S.; Ramchandani, M. G. pp 379-380 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

A computer calculation was performed for the isotropic Knight shift in cadmium, obtaining the Pauli spin susceptibility through the density of states at the Fermi energy. The calculated value was 0.305%, compared with experimental values obtained at 4.2 K of 0.300%, 0.350%, and 0.338%.

9442 DIFFUSION OF LANTHANUM IN LIQUID URANIUM. Yang, R.; Hovingh, J.; LeBorgne, E.; Olander, D. R. (Univ. of California, Berkeley). High Temp. Sci.; 7: No. 1, 55-60(Mar 1975).

Results of measurements of La diffusion in U are presented in a plot of time vs activity level. The plot is used in determining the diffusion coefficient. The value of the diffusion coefficient was found to be 1.5×10^{-5} cm/s. (JRD)

9443 SOLID SOLUTION SOFTENING AND STRAIN-RATE SENSITIVITY OF Fe-Re AND Fe-Mo ALLOYS. Leemans, D.; Fine, M. E. Metall. Trans.; 5: No. 6, 1331-1336(1974).

Fe-Re alloys, well within the solid solution range, were measured vs. temperature and compared with previous results for Fe-Ti alloys. The strain-rate sensitivity-temperature curves shifted systematically to lower temperature as solute was added. The resolved shear stress was divided into two parts, a dynamic part which is a function of strain-rate and a static part which is not. The strain-rate sensitivity data were inverted to give the dynamic part of the flow stress and this was subtracted from the resolved shear-stress to give the static part of the flow stress. Significant solid solution softening occurred in the dynamic part of the flow stress at 166 and 196°K. This is due to intrinsic effects and not to scavenging of impurities. The static part of the flow stress is made up of two parts, a peaking effect superimposed on normal solid solution hardening. (Metals Abstr.)

9444 INFLUENCE OF HEAT TREATMENTS ON MICROSTRUCTURES IN AN Fe-Co-V ALLOY. Mahajan, S.; Pinnel, M. R.; Bennett, J. E. Metall. Trans.; 5: No. 6, 1263-1272(Jun 1974).

The microstructural changes in an Fe-Co-V alloy (composition by wt.-percent; 2.97 V, 48.70 Co, 47.34 Fe, balance impurities such as C, P and Ni) resulting from different heat treatments have been evaluated by optical metallography and transmission electron microscopy. Results indicate that, on air cooling or quenching into iced brine from the high-temperature single-phase gamma (fcc) field, V can be retained in a supersaturated solid solution ($alpha_2$) which has bcc structure. For the range of cooling rates employed, a portion of the material appears to undergo the gamma-$alpha_2$ transformation massively and the remainder martensitically. On annealing in the two-phase $alpha_1$ + gamma field, $alpha_2$ decomposes into V-rich subgrains (gamma) and V-poor subgrains ($alpha_1$) and only the former undergo the gamma yields $alpha_2$ transformation during air cooling or iced brine quenching. The $alpha_1$ subgrains in a sample, slowly quenched in quartz, show superlattice dislocations and antiphase boundaries, whereas both the transformed and untransformed areas exhibit (100) superlattice reflections. The two-phase annealing sequence followed by a 2 h anneal at 600°C and air cooling results in precipitation within the V-rich, transformed subgrains. Also, there is evidence of long-range order in both types of subgrains. (Metals Abstr.)

9445 LIQUID METAL COEXISTENCE PROPERTIES FROM CORRESPONDING STATES AND THIRD LAW. Hornung, K. (Max-Planck-Institut für Physik und Astrophysik, Institut für

Extraterrestrische Physik 8046 Garching, West Germany). J. Appl. Phys. 46: No. 6, 2548-2558 (June 1975).

An empirical procedure is introduced to describe equilibrium thermodynamic properties of metals from the experimentally covered region ($0.2T_c \lesssim T \lesssim 0.4T_c$) over a very large temperature interval up to near the critical point ($0.4T_c \lesssim T \lesssim T_c$). The method uses arguments of corresponding states for the extrapolation of the *interphase properties*, like vapor pressure, heat of vaporization, or coexistence volumes, whereas the *liquid properties*, entropy, or specific heat, are determined from the gas side applying a third-law technique. Resulting high-temperature data may be used for practical description of two-phase processes as well as for estimation of basic liquid properties. Special application to a set of different metals (Li, Na, Sr, Ba, Pb, U, Fe, Eu), as an example, gave information about large-scale deviations of the liquid specific heat from quadratic temperature dependence (especially transition metals), and about the size of the critical compressibility $Z_c = p_c V_c / RT_c$, which seems to be much closer to a common value of about 0.4 than previously assumed. (auth)

9446 THE SPECIFIC HEAT OF Nb-25% Zr. Wright, L.S.; Pendrys, J.P.; Harrison, R.B. (Royal Military College of Canada, Kingston, Ontario K7L 2W3, Canada). J. Appl. Phys. 46: No. 6, 2745-2746 (June 1975).

The specific heat of cold-rolled Nb-25% Zr has been measured from 2 to 11.6 K in zero magnetic field. The transition temperature has been found to be 10.9 ± 0.05 K and the specific heat below the transition temperature is reasonably well represented by $C = 1954 \exp(-1.874 T_c/T) + 0.16 T^3$ mJ/mole K. (auth)

9447 OPTICAL AND DIELECTRIC CONSTANTS OF HAFNIUM AND ITS ANODIC OXIDE FILMS. Saxena, A.N. (International Science Company, Princeton Junction, New Jersey 08550); Mittal, K.L. J. Appl. Phys. 46: No. 6, 2788-2789 (June 1975).

Optical and dielectric constants of Hf films deposited by sputtering were measured at a wavelength of 546.1 nm using ellipsometry. The thicknesses of the films deposited were 300 nm. Also, ellipsometric results are reported for HfO_2 films obtained by anodizing Hf films at various forming voltages. The average value of the refractive index n_1 of HfO_2 films was found to be 2.09 and it remains essentially constant for the range of thickness (12.5–53.7 nm) studied. (auth)

9448 A $PrCu_6$ CRYOSTAT FOR NUCLEAR ORIENTATION EXPERIMENTS DOWN TO 2.7 mK. Andres, K.; Hagn, E.; Smolic, E. (Physics Department, Technical University of Munich, Garching, Germany); Eska, G. J. Appl. Phys. 46: No. 6, 2752-2759 (June 1975).

An adiabatic demagnetization cryostat has been modified to include a second hyperfine enhanced nuclear cooling stage with $PrCu_6$ as the working material. The details of the design are given and the performance of the cryostat is discussed. The reliability of ^{60}CoFe and ^{60}CoNi nuclear orientation thermometers are critically evaluated. (auth)

9449 SURFACE DIFFUSION PROCESSED MULTIFILAMENT Nb_3Sn CONDUCTORS. Deis, D.W.; Shaw, B.J. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). J. Appl. Phys. 46: No. 6, 2737-2738 (June 1975).

Multiple coats of Sn have been applied to a Nb-Cu composite multifilament conductor and processed to form Nb_3Sn layers on each filament. The critical current has been evaluated in fields up to 48 kG at 4.2 K and resistivity and critical temperatures measured. Electron microprobe and scanning electron microscope techniques have been used to investigate the Sn and Nb_3Sn distributions within a reacted conductor. (auth)

9450 THE DIFFUSION OF LITHIUM IN MOLYBDENUM. Wu, C.H. (Institut für Nuklearchemie der Kernforschungsanlage Jülich, GmbH, 517 Jülich, West Germany). J. Chem. Phys. 62: No. 12, 4589-4591 (15 June 1975).

The diffusion coefficient of ^{7}Li through molybdenum at temperatures around 950 °K has been measured. The diffusion coefficient in dependence on temperature can be expressed by $D = D_0 e^{-Q/RT}$, where $D_0 = 0.65$ cm^2 sec^{-1} and $Q = 1.46 \pm 0.10$ eV. (auth)

9451 MODEL STUDIES OF CHEMISORPTION. INTERACTION BETWEEN ATOMIC HYDROGEN AND BERYLLIUM CLUSTERS. Bauschlicher Jr., C.W.; Liskow, D.H.; Bender, C.F.; Schaefer III, H.F. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). J. Chem. Phys. 62: No. 12, 4815-4825 (15 June 1975).

The interaction between hydrogen atoms and Be metal clusters has been studied by *ab initio* electronic structure theory. Self-consistent-field (SCF) calculations have been carried out using both minimum and larger basis sets of contracted Gaussian functions. Both spatially restricted and unrestricted SCF methods were used, and different results were obtained in several cases. Reasons for the choice of this particular model system are discussed. Clusters as large as ten Be atoms have been considered, as have four different sites for the approach of the H atom. The electronic structure is discussed on the basis of predicted orbital energies and Mulliken atomic populations. (auth)

9452 INITIAL PERMEABILITY OF A TERBIUM SINGLE CRYSTAL. Oosthuizen, C. P.; Alberts, L. (Rand Afrikaans Univ., Johannesburg). Int. J. Magn.; 6: No. 3-4, 247-249(1974).

Measurements of the initial magnetization in various crystallographic directions were performed on a single crystal of terbium in the ferromagnetic range. The results for the basal plane indicate the existence of relatively large domains and few domain walls. The c axis measurements are explained in terms of domain vector rotation against the high anisotropy forces. (auth)

9453 FEATURES OF THE CURRENT-VOLTAGE CHARACTERISTICS AND PEAK EFFECT IN DEFORMED SINGLE CRYSTALS OF SUPERCONDUCTING NIOBIUM. Vinnikov, L.Ya.; Zharikov, O.V. (Institute of Solid-State Physics, Academy of Sciences of the USSR, Chernogolovka). Sov. Phys.—Solid State 16: No. 10, 2042-2043 (Apr 1975).

The current-voltage characteristics of samples of NVCh grade of niobium crystals deformed along the ⟨100⟩ directions by 2–10% were studied.(AIP)

9454 ANOMALY IN THE ELECTRICAL RESISTIVITY OF EUROPIUM IN THE VICINITY OF THE NÉEL POINT. Barskii, I.M.; Boyarskii, L.A.; Dikovskii, V.Ya. (Institute of Inorganic Chemistry, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.—Solid State 16: No. 10, 1995-1997 (Apr 1975).

The temperature dependence of the electrical resistivity of europium has been measured by a potentiometric method over the range 4.2-300°K. A detailed study has been made of the anomaly in the electrical resistivity that occurs in the vicinity of the antiferromagnetic transformation point $T_N \simeq 89$°K. It is shown that below T_N the derivative of the resistivity in the range $\tau_c < \tau < 0.12$ is represented by a power law with an index of -0.33, in agreement with published data. In the immediate vicinity of the transformation there is an increase in the anomaly in (dR/dT)(T) at $\tau < \tau_c$, its form in this range depending to a great extent on the degree of deformation. Such a change in the nature of the anomaly is due to the presence of a first-order phase transformation in europium. Comparison of the temperature dependence of the resistivity derivative with that of the magnetic part of the specific heat shows that a direct proportionality exists between them at $T < T_N$. (auth)

9455 MAGNETIC SUSCEPTIBILITY OF TERBIUM-HOLMIUM ALLOYS NEAR THE NÉEL POINT. Boyarskii, L.A.; Zemerov, F.M.; Romanenko, A.I. (Institute of Inorganic Chemistry, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.—Solid State 16: No. 10, 2011-2012 (Apr 1975).

We have investigated the temperature dependence of the magnetic susceptibility of terbium-holmium alloys close to the equiatomic ratio. The temperature range from 160° to 300°K was studied.(AIP)

9456 EFFECT OF TRANSITION ELEMENTS ON THE HOMOGENIZATION OF ALUMINUM-MAGNESIUM ALLOYS. Litvin, B. N. (Dnepropetrovsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, 122-125(1975). (In Russian).

An analysis of the effect of transition elements in amounts of 0.05 to 0.40 wt % on the structure of cast Al—Mg alloys containing 12 wt % Mg showed that the best fine-graining agents are Co, Ce, V, Nd, Zr, Nb, Fe, and Ti which elements are introduced in amounts respectively of 0.025, 0.05, 0.025, 0.020, 0.050, 0.030, 0.050, and 0.20 at. %. A technique is presented for separately determining the dissolution time of the beta phase (Al_3Mg_2), the reduced time for dissolving the beta phase, and the time of complete homogenization. It was established that at a content of Nb, V, Ta, Ti, and Zr in amounts of 0.1 to 0.2 at. % in the Al—Mg alloy and at a crystallization rate on the order of 5°/s the main part of these elements is in solid solution, and increases the reduced time for dissolution of the beta phase by a factor of 1.5 to 2, and the time of complete homogenization by a factor of 2 to 3. Neodymium and cerium in amounts of 0.05 at. % are dissolved in the beta phase, and increase the time of dissolving the beta phase but have only a slight effect on the time of complete homogenization. Rhenium is also dissolved in the beta phase, but accelerates the reduced time of dissolving the beta phase, and has a slight effect on the time of complete homogenization. (SJR)

9457 ELASTIC ANISOTROPHY AND TEXTURE OF ROLLED ZIRCONIUM. Bryukhanov, A. A.; Ivanii, V. S.; Vasyliv, V. I. (Odessa State Inst.). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, 110-115(1975). (In Russian).

The presence of a nonbasal texture in rolled, alpha zirconium makes the sheet anisotropic with respect to Young's modulus (tensor of the 4th rank), thermo-emf and electrical resistance (tensor of the 2nd rank). Harmonic analysis of the elastic anisotrophy data and roentgenographic studies show that the primary recrystallization texture can be described by an orientation close to (0001), [11$\bar{2}$0] with an inclination of (0001) to the plane of the sheet at an angle on the order of 34°. The geometrical connection between the rolling and recrystallization textures is accomplished

by inclining the basal plane with respect to the direction of rolling by an angle on the order of 5°, and also by rotating it about its normal by an angle of 30°. (SJR).

9458 PHYSICAL-CHEMICAL CONDITIONS OF VANADIUM CARBIDE PRECIPITATION. Permyakov, V. G.; Loskutov, V. F.; Byakova, A. V. (Kiev Polytechnical Inst.). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 2, 87-89(1975). (In Russian).

Results are presented of thermodynamic calculations of possible reactions for the formation of vanadium carbides on saturation of iron and steel. For introducing vanadium carbides to the surface of a metal it is possible to use vanadium powder (ferrovanadium) and the halides CCl_4 and $(C_2F_4)_n$. The presence of an excess amount of vanadium in the reaction space can have a substantial effect on the phase composition of the carbide covering. (SJR)

9459 COMPUTER SIMULATION STUDY OF THE STRUCTURE OF TWIN BOUNDARIES IN BODY-CENTERED CUBIC CRYSTALS. Bristowe, P. D.; Crocker, A. G. (Surrey Univ., Guildford, Eng.). Philos. Mag.; 31: No. 3, 503-517(Mar 1975).

The structures of (112) twin boundaries in body-centered cubic crystals have been studied using computer simulation methods and interatomic potentials representing iron, molybdenum, and tungsten. Two distinct structures were found to be stable or metastable in the models used. These were the conventional twin boundary defined by a reflection orientation relation and a twin in which the boundary consisted of a layer of cells which project on the $(1\bar{1}0)$ plane as interlocking isosceles triangles. In the case of iron the two boundaries, when fully relaxed, are found to have almost identical energies but for molybdenum and tungsten the reflection boundary is preferred. The twin boundary energies for these two metals are larger than those for iron. Volume increases are predicted for the reflection twins in all three metals but for molybdenum a surprising volume decrease arises for the isosceles twin. The results suggest that in some bcc metals both types of boundary may arise in which case each twinning dislocation is likely to be dissociated into two partials, each with Burgers vector $1/12(\bar{1}\bar{1}1)$. The reliability of the computer simulation method for investigating the structure of crystal interfaces, such as twin boundaries, is discussed. (auth)

9460 SPIN RESONANCE OF Gd IN $LaOs_2$. Schrittenlacher, W.; Baberschke, K.; Koopman, G.; Huefner, S. (Univ. Freie, Berlin). Solid State Commun.; 16: No. 7, 923-925(1 Apr 1975).

Spin resonance has been observed in the normal and superconducting state of Gd in the C-15 superconductor $LaOs_2$. The electron-impurity relaxation rate allows the prediction of the Abrikosov-Gorkov depression of T_c. A field dependent "g-shift" is observed in the superconducting state. (auth)

9461 ANOMALOUS MAGNETIC CRITICAL BEHAVIOR OBSERVED IN NEUTRON SCATTERING FROM HoSb AND DySb. Taub, H.; Parente, C. B. R. (Brookhaven National Lab., Upton, NY). Solid State Commun.; 16: No. 7, 857-860(1 Apr 1975).

Neutron diffraction measurements on HoSb and DySb show an anomalously large intensity from magnetic critical scattering above a well-defined Neel point T_N. The origin of this unusual critical behavior above T_N is not understood at present, although it appears related to strong magnetoelastic coupling which for both systems results in a cubic-to-tetragonal lattice distortion at T_N. (auth)

9462 MAGNETIC FORM FACTOR FOR LIQUID Ce. Enderby, J. E.; Nguyen, V. T. (Univ. of Leicester, Eng.). J. Phys., C (London); 8: No. 7, L112-L114(7 Apr 1975).

A magnetic form factor for liquid Ce has been determined for the first time by comparing the differential scattering cross section of thermal neutrons for liquid Ce with that for liquid La. It is concluded that although the form factor is consistent with the dipole approximation and a $^2F_{\frac{5}{2}}$ spectroscopic state for Ce^{3+}, roughly 20% of the Ce ions in the liquid state are instantaneously magnetically inactive. (auth)

9463 FLUX FLOW NOISE SPECTRA OF TYPE II SUPERCONDUCTORS. Thompson, J.; Joiner, W. C. H. (Univ. of Cincinnati). Solid State Commun.; 16: No. 7, 849-851(1 Apr 1975).

Measurements of the flux flow noise have been made in foil samples of $Pb_{80}In_{20}$. The results obtained cannot be explained by previous models which assume direct transit of fluxoids across sample. However, using a model based on the assumption that the flux motion is interrupted by pinning centers it is possible to obtain a good fit to the measured noise curves. Good agreement is also obtained between the calculated and measured critical frequencies using this model. These results may also help explain certain features of noise measurements reported by other workers. (auth)

9464 SUPERCONDUCTIVITY IN METASTABLE Pd-ALLOYS PRODUCED BY ION IMPLANTATION AT LOW TEMPERATURES. Stritzker, B.; Becker, J. (Kernforschungsanlage, Juelich, Ger.). Phys. Lett.; 51A: No. 3, 147-148(24 Feb 1975).

Superconductivity was observed in Pd after implantation of H, D, B and C at liquid He-temperatures. The results support the assumption of a large electron-phonon coupling by partially unscreened protons and deuterons. (auth)

9465 CORRELATED THERMAL DISPLACEMENT IN BCC METALS. Jackson, D. P.; Powell, B. M.; Dolling, G. (Atomic Energy of Canada Ltd., Chalk River, Ontario). Phys. Lett.; 51A: No. 2, 87-88(10 Feb 1975).

Calculations based on experimental phonon frequency distributions show that significant equal-time displacement correlations are present in niobium and molybdenum lattices. (auth)

9466 PROCEEDINGS OF THE SECOND INTERNATIONAL CONFERENCE ON SOLID SURFACES, KYOTO, JAPAN, MARCH 25–29, 1974. Kumagai, H.; Toya, T. (eds.). Japanese Journal of Applied Physics, Supplement 2, Part 2, 1974. Tokyo; Japanese Journal of Applied Physics (1974). 945p. (CONF-740368-).

A total of 212 papers and abstracts are presented covering the following topics: (1) surface migration; (2) gas-solid reactions; (3) chemisorption on metal surfaces; (4) physisorption on solid surfaces; (5) adsorption and reactions on semiconductor surfaces; (6) quantum transport on semiconductor surfaces; (7) structures and electronic states of semiconductor surfaces; (8) catalytic reactions on solid surfaces; (9) atom- and ion-solid scattering; (10) electron-solid scattering; (11) electronic properties of metal surfaces; (12) photoelectron spectroscopy; (13) Auger electron spectroscopy; (14) electron spectroscopy of chemisorbed atoms and molecules; and (15) surface waves. Abstracts for 45 of the papers are included in NSA, many of them dealing with the surface properties of tungsten, particularly the sorptive properties. (auth)

For abstracts of individual papers see: 9349–9350, 9380–9381, 9467–9503, 9588, and 9613–9615.

9467 FIELD ION MICROSCOPE STUDY OF METAL–METAL INTERACTIONS AT INTERFACES. Nishikawa, O. (Pennsylvania State Univ., University Park). Jap. Appl. Phys.; No. Suppl. 2, 37-42(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The application of field ion microscopy to the study of interfaces was extended to Ga, In and Sn on W, Mo, Ir and Re. Regularly ordered pseudomorphs and various superstructures were observed only for Ga–W and In–W. The observed high evaporation fields of Ga, Ir and Sn indicated the large binding energies at the interfaces. The deposited atoms were imaged with various brightnesses and might be invisible in the two-dimensional alloys. The disordered surface caused by a contact or by heating exhibited a higher evaporation field than that of the substrate. The effects of the deposits on the thermal end form and surface rearrangements were observed. The observed phenomena are explained as the result of transitions between electron states, the formation of two dimensional alloys and promoted migration induced by the increased surface energy. (auth)

9468 SURFACE STUDIES USING ION ENERGY DISTRIBUTION OF FIELD IONIZED GASES ON METAL SURFACES. Utsumi, T. (Bell Labs., Murray Hill, NJ). Jap. Appl. Phys.; No. Suppl. 2, 47-50(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The experimental results and their analysis on the energy distribution of field ionized gaseous species on tungsten surfaces are presented. With the noble gases (He and Ne) the observed energy distribution on W(110) and W(100) shows the main peaks plus a series of field induced resonance peaks which was observed first by Jason. The observed shapes and positions of these resonance peaks are discussed. With hydrogen, it was shown that the field ionization of the molecular hydrogen is nonvertical Frank-Condon transition and the orientation of H_2 at the instant of the ionization is nearly random up to the field of 4 V/Å. Also our experimental observations and subsequent analysis of H_3^+ formation strongly support that the reaction kinetics is H_2^+ (field ionized) + H_2 (adsorbed due to dipole-dipole interaction on the protruding tungsten atom) → H_3^+ + H. (auth)

9469 STUDY OF REMOLDING PROCESS OF W TIP WITH FEM AND 3MV ELECTRON MICROSCOPE. Kim, H. (Coll. of Naval Architecture, Nagasaki); Inoue, T.; Hanawa, T.; Sugata, E. Jap. Appl. Phys.; No. Suppl. 2, 59-62(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The remolding process of $\langle 110\rangle$, $\langle 310\rangle$, $\langle 111\rangle$ and $\langle 100\rangle$ oriented tungsten single crystal tips was observed using FEM and a 3 MV electron microscope. At a pressure of 10^{-10} Torr, the {110}, {211}

and {100} planes are enlarged in the initial stage of remolding process in all of the single crystal wires followed by ridge formation on the {111} and {310} planes, and, finally, a spot formation at and near the (310) plane. Field emission current varied in three steps according to the migration process, having activation energies of 1.9, 1.26 and 0.64 eV. The activation energy for the blunting process of the spot is 2.3 eV, which indicates a defective crystal. Observations of the remolded tips in the 3 MV electron microscope reveal dislocations along the wire axis, the ridge direction, the slip plane, and the direction normal to surface. The spot radius measured by FEM is larger than the value obtained with the 3 MV electron microscope. (auth)

9470 THERMAL DECOMPOSITION OF BI_3 ON Mo FIELD EMITTER SURFACES. Moore, R. E.; Ownby, P. D. (Univ. of Missouri, Rolla). Jap. Appl. Phys.; No. Suppl. 2, 71-74(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Boron was adsorbed onto molybdenum field emitter surfaces by the thermal decomposition of boron triiodide at corrected partial pressures of 1.4×10^{-9} Torr to 4.5×10^{-9} Torr. Based on field emission work function data and an analytical work function versus adsorbate-coverage relationship, a quantitative measure of the monolayer coverage of boron on molybdenum was determined, 6.3×10^{14} atoms/cm^2/monolayer. A parameter, β, is defined which is a measure of the effective yield of adsorbed boron on molybdenum from BI_3. β is formulated in terms of the free energy of dissociation of the BI_3 molecule on and the free energy of desorption of the BI_3 molecule from the molybdenum surface. These energies were determined from the data to be -34.4 ± 2 kcal/mole and 4.5 ± 4 kcal/mole, respectively. (auth)

9471 SURFACE DIFFUSION OF THE ALKALI METAL ATOMS ON W INFLUENCED BY THE SURFACE STRUCTURE. Koerner, W. (Univ., Marburg, Ger.). Jap. Appl. Phys.; No. Suppl. 2, 75-78(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The diffusion length $\bar{x}$ of K, Rb and Cs on W-(100)-vicinals was measured using a thermal ion-microscope. The distribution of the ion-current density, which desorbs from the surface, is registered in the vicinity of a vapor deposition limit. At low temperatures the investigation concerning the plateau of this distribution shows that there exist W-(100)-islets at the grain-boundaries. Their adsorption energy surmounts that of the (100)-areas by $\Delta Q \sim 0.4$ eV. Although the islets contribute only about 10^{-3} to the total area, most of the current desorbs from them, provided that $\bar{x} > 50$ μm. The analysis of the ion-current from the (100)-faces enables the determination of the diffusion length $\bar{x}$ of the atoms moving to the islets. Both quantities $\bar{x}$ and x lead to the same diffusion coefficient $D = 7.9$ cm^{2}s^{-1} exp [$\pm 0.7 - (0.86 \pm 0.08)$eV/kT] corresponding to the ledges in the (100)-vicinals. (auth)

9472 INITIAL OXIDATION OF Mo(110) SURFACE OBSERVED BY AES AND LEED. Miura, T.; Tuzi, Y. (Univ. of Tokyo). Jap. Appl. Phys.; No. Suppl. 2, 85-88(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Oxidation of molybdenum (110) surface was observed by Auger electron spectroscopy (AES) and LEED. The surface was oxidized at 500°C in $10^{-4} \sim 10^{-6}$ Torr of oxygen. The ratios of oxygen to molybdenum Auger peak intensities increased markedly at exposure of about 10^{-3} Torr sec of oxygen. The ratios remained constant for further exposure, probably because of complete oxidation within the escape depth of the oxygen Auger electrons. The surface and bulk plasma loss peaks shifted with exposure, reached the value of oxide at exposure of about 10^{-2} Torr sec, and thereafter remained constant. The LEED pattern became diffuse with progress of oxidation and disappeared at about 10^{-2} Torr sec. These results suggest the growth of amorphous oxide layer. The initial surface was proved to be very clean by AES and LEED. (auth)

9473 ADSORPTION AND REPLACEMENT OF CH_4, CO, AND NO ON EVAPORATED FILMS OF Ti AND W. Sugita, T.; Ebisawa, S. (Electrotechnical Lab., Tokyo). Jap. Appl. Phys.; No. Suppl. 2, 113-116(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The adsorption, surface reaction, and mutual replacement of CH_4, CO, and NO on the films of titanium and tungsten evaporated under ultra-high vacuum condition were studied with a combined Knudsen flow capillary method and mass spectrometer system. When CH_4-covered surfaces are exposed to gaseous CO or NO at room temperature and 77 K, the appearance of both CH_4 and complex produced by the reaction of CH_4 with CO or NO in the gas phase is noted. However, when the surface with preadsorbed CO or NO are exposed to gaseous CH_4, CH_4 does not remove CO, NO, and the complex from the surfaces. (auth)

9474 LEED, AUGER, AND WORK-FUNCTION STUDY OF O/Cs ADSORPTION AND COADSORPTION ON (100) W. Desplat, J. L. (CEN de Saclay, Gif-sur-Yvette, France). Jap. Appl. Phys.; No. Suppl. 2, 177-180(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Oxygen or cesium adsorption and coadsorption on a (100) tungsten crystal at room temperature were studied by work-function measurements ϕ (Kelvin Method), Auger electron spectroscopy (AES), and LEED. Cesium adsorption results are in accordance with already known studies, except for new features in the Auger spectrum. For oxygen adsorption, a close agreement is found with other ϕ-measurements, and a complex evolution in LEED patterns suggests the onset of oxidation. The increase in the dipole moment of cesium adsorbed on oxygen covered W(100) accounts for the lowering of the work function minimum and for the increase in the cesium monolayer density shown by AES, in qualitative agreement with the theoretical approach. However the cesium coverage at ϕ minimum seems not to be reduced by oxygen. A new peak in the Auger spectrum, associated with coexisting oxygen and cesium, suggests the existence of cesium oxide. (auth)

9475 SCANNING ELECTRON INDUCED DESORPTION STUDY OF SURFACE F MIGRATION. Lichtman, D.; Campuzano, J. (Univ. of Wisconsin, Milwaukee). Jap. Appl. Phys.; No. Suppl. 2, 189-192(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

A focused electron beam was used to scan the surface of a substrate sample, the resulting electron induced desorbed ions were mass analyzed, and the signal thus obtained was used to intensity modulate an output display. The technique was used to monitor the spatial distribution of the F^+ signal desorbed by electron interaction with a tungsten ribbon substrate. Results obtained indicate considerable surface migration of the fluorine, or more probably the fluorine containing molecule. Rapid (flash) heating causes primarily thermal desorption, while slow heating results in rapid surface migration to the sample support rods. (auth)

9476 LEED STUDY OF HALOGEN ADSORPTION ON W: TWO DIMENSIONAL SHEAR STRUCTURES. Avery, N. R. (Univ. of Milbourne, Parkville, Australia). Jap. Appl. Phys.; No. Suppl. 2, 193-196(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The dissociative chemisorption of iodine and bromine on tungsten single crystal surfaces was studied by LEED. Iodine adsorption on W(110) produced long chain structures which could be divided into three families of phases (β_1, β_2 and β_3) distinguishable by the arrangement of atoms within the chain. Continuous changes in coverage occurred by sheets of these well-ordered chain structures shearing relative to each other to produce packing faults at the resulting shear line. Although bromine on W(110) produced two comparable chain structures, shearing did not occur with changing coverage. Iodine on W(100) failed to produce either chain or shear structures. The lateral adatom interactions responsible for the stability of these structures is discussed. (auth)

9477 INVESTIGATION OF O ADSORPTION ON W AT HIGH TEMPERATURES BY AUGER ELECTRON SPECTROSCOPY. Bas, E. B.; Baenninger, U. (Swiss Federal Inst. of Tech., Zurich). Jap. Appl. Phys.; No. Suppl. 2, 197-200(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Oxygen adsorption on tungsten was studied at high temperature by Auger electron spectroscopy using a special object stage with small cylindrical object and electron bombardment heating. No temperature effects were observed on the character of Auger electron spectra up to 3000 K. The study of the decarbonization process of tungsten shows that small contamination of carbon on the surface influences strongly the equilibrium oxygen coverage. Adsorption isotherms of carbon free surfaces was measured up to 10^{-4} Torr in the temperature range from 1600 K to 2700 K on polycrystal faces. The measured isotherms can be interpreted assuming a second order desorption. A specially formed object was used to investigate whether the electron bombardment heating is influencing the adsorption equilibrium, but no influence on adsorption isotherms was found. (auth)

9478 SOME ASPECTS OF THE CO–W SYSTEM. Gomer, R. (Univ. of Chicago). Jap. Appl. Phys.; No. Suppl. 2, 213-224 (1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The adsorption of CO on tungsten is discussed in the light of thermal and electron impact desorption, as well as photoemission and field emission spectroscopy. The evidence for the existence of several low and intermediate temperature binding states is discussed, and the nature of the states interpreted in terms of undissociated CO. The high temperature binding modes are also discussed, and it is suggested that the present evidence does not permit a distinction between dissociated and undissociated adsorption although both C and O seem to be in contact with W atoms. (auth)

9479 ADSORPTION OF NO ON W. Usami, S.; Nakagima, T. (Yokohama National Univ., Japan). Jap. Appl. Phys.; No. Suppl. 2, 237-240(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The characterization of the W(100) surface adsorbing nitric oxide at room temperature was conducted with the conventional LEED and AES technique. Nitric oxide on the W(100) shows ordered (2×2) and (4×1) patterns at the exposure of $\simeq$0.8 L and $\simeq$1.6 L respectively without any heat treatment. The sequential heating of the fully NO-covered surface revealed (2×2), (4×1) and (2×1) structures. In the AES, as the exposure was increased, the nitrogen and oxygen peaks did not grow at the same rate, the latter keeping nearly constant over the exposure of about 3 L. The surface potential of nitric oxide on W(100) was found to be -1.52 ± 0.03 V by the retarding field method. (auth)

9480 ELECTRON STIMULATED DESORPTION (ESD) AND THERMAL DESORPTION (TD) STUDY OF NH_3 ON Mo. Goymour, C. G.; Abon, M.; Bergeret, G.; Tardy, B.; Teichner, S. J. (CNRS, Villeurbanne, France). Jap. Appl. Phys.; No. Suppl. 2, 245-248(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

ESD and TD techniques were used to study the adsorption and thermal decomposition of ammonia on a polycrystalline molybdenum sample. The TD results suggest a two stage mechanism for the thermal decomposition of ammonia into hydrogen and nitrogen. (auth)

9481 SLOW ELECTRON SPECTROSCOPY ON Mo(100). Ballu, Y.; Lecante, J. (CEN de Saclay, Gif-sur-Yvette, France). Jap. Appl. Phys.; No. Suppl. 2, 249-252(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The backscattered electron energy distribution was measured using a high resolution cylindrical electron spectrometer. Characteristic energy losses were observed for a clean Mo(100) surface and for the same surface covered by oxygen. The surface plasmon loss peak was identified by its position and intensity dependence on oxygen adsorption, and by optical data. Interband transitions were also observed, which may be classified in three categories: (1) bulk transitions of Mo in agreement with optical data: (2) transitions very sensitive to the surface state (they disappeared with adsorption of small quantities of hydrogen and oxygen, and their energy and sensitivity suggest their identification as surface state transitions); and (3) new transitions due to the adsorbed molecules. (auth)

9482 INFRARED REFLECTION-ABSORPTION STUDY OF MOLECULAR ADSORPTION ON METALS. Greenler, R. (Univ. of Wisconsin, Milwaukee). Jap. Appl. Phys.; No. Suppl. 2, 265-268(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Reflection-absorption spectroscopy has been shown to yield, in some cases, the infrared spectrum of as little as a few percent of a monomolecular layer of adsorbate on an extended metal surface. In order to maximize the sensitivity of the technique, there is an optimum number of reflections which depends on the angle of incidence and the optical constants of the metal. In a number of cases, using only one reflection, a sensitivity comparable with that produced by using the optimum number can be obtained. With only one reflection, the experimental procedure is simplified, and the reflection-absorption experiment can be applied to a sample studied simultaneously with other surface probes. (auth)

9483 OBSERVATION OF SURFACE STATES OF Si, Ge, W, AND Mo. Murotani, T.; Fujiwara, K.; Nishujima, M. (Mitsubishi Electric Corp., Ltd., Amagasaki, Japan). Jap. Appl. Phys.; No. Suppl. 2, 409-412(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Electronic surface states of Si, Ge, W, and Mo were investigated by measurements of ultraviolet photoemission spectra. Emission from the surface states is observed from the cleaved Si (111) and Ge (111) surfaces. Changes are observed in the spectra after annealing these surfaces, and results are presented in connection with the surface reconstruction. Surface sensitive peaks were observed from W and Mo, whose peak energies are in agreement with a band calculation. (auth)

9484 NO AND ITS DECOMPOSITION ON THE (110) PLANE OF W. Klein, R.; Yates, J. T. Jr. (National Bureau of Standards, Washington, DC). Jap. Appl. Phys.; No. Suppl. 2, 461-464(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Nitric oxide is adsorbed on the (110) plane of tungsten with a high sticking coefficient independent of coverage. Programmed thermal desorption of a W(110) surface with adsorbed NO shows no desorbed NO, but only nitrogen. Two peaks are observed in the resulting nitrogen desorption spectra. The first, appearing at low coverages of NO, shifts to lower temperatures with increasing initial coverage. The second appears at higher coverages and shifts slightly to higher temperatures with increasing coverage. The temperature region covering both states is 900–1350 K for the temperature rates employed. A simple, consistent model is developed. Work function-relative coverage measurements for NO on W(110) show an initial slow $\Delta\phi$ increase, a linear portion, and a maximum. The maximum $\Delta\phi$ is 0.85 eV and the saturated coverage value is 0.72 eV. (auth)

9485 FIELD ION MASS SPECTROMETRY OF O, S, AND Se AT DIFFERENT METAL SURFACES. Block, J. H. (Max-Planck-Gesellschaft, Berlin). Jap. Appl. Phys.; No. Suppl. 2, 505-511 (1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

A review is given on recent results of field ion mass spectrometry and other techniques concerning the interaction of oxygen (and some other gases) on silver, sulfur and selenium on platinum, and sulfur on tungsten surfaces. Field electron emission and field ionization microscopy as well as kinetic, IR, and EPR measurements indicate unambiguously different adsorption states of oxygen on silver. The oxygen adsorption is influenced by the electric field. Although stable silver-oxygen ions are known, no field ions of these surface compounds can be desorbed, if molecular oxygen is interacting. On platinum the two stable adsorption states of sulfur are the strongly adsorbed α-state (desorbing at $T > 1200$ K) and an adsorbed β-state (desorbing at $T > 570$ K). A third transient phase of adsorbed sulfur is observed only at saturation of the stable states if S_2 is further supplied. On tungsten the two sulfur adsorption states are a less mobile (in average $T > 400$ K) strongly chemisorbed form and a second less stable layer. Field ion mass spectra in combination with "field impulse" techniques indicate the presence of S_5, S_6, S_7 and S_8 on W. A comparison is made with field ion mass spectra of selenium where even higher ion clusters occur. (auth)

9486 ADSORPTION AND DECOMPOSITION OF ACETYLENE ON POLYCRYSTALLINE Re FILMS AND RIBBONS. Niclou, Y.; Ehrhardt, J. J.; Ducros, R.; Cassuto, A. (CNRS, Nancy). Jap. Appl. Phys.; No. Suppl. 2, 521-524(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Acetylene interactions with rhenium ribbons and evaporated films were studied in an ultrahigh vacuum apparatus by uptake measurements and thermal desorption monitored by mass spectrometry and Auger electron spectroscopy. Results are similar on both types of samples despite strong differences in crystallographic structure. At room temperature, the initial sticking coefficient is close to unity. C_2H_2 is dissociated on the surface at low coverages, leading to mobile hydrogen atoms. At saturation, the composition of the residue left on the surface is $C_2H_{1.5}$ at 293 K and C_2H_2 at 200 K. Thermal desorption shows two hydrogen peaks coming from the residue decomposition. Results of acetylene and ethylene adsorption are compared and shown to be similar. A model, assuming several surface sites, with different adsorption properties is proposed. (auth)

9487 MEASUREMENT OF MEAN RESIDENCE TIMES OF K ON CLEAN AND CONTAMINATED W SURFACES. Isa, K. (Kyoto Univ.); Kusunoki, I.; Kodera, K. Jap. Appl. Phys.; No. Suppl. 2, 583-586(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The mean residence time ($\bar{\tau}$) of potassium atoms, ions, or their intermediate states on clean and contaminated tungsten surfaces was studied by means of a pulsed molecular beam method. Taking into consideration the shape of the gate function, which can be determined from the experiment, and assuming the transient adatoms (M) and adions (M^+) are in equilibrium, we estimated

$\bar{\tau}$ by a new method of analysis from the measured intensity function of desorbed ions. Using an Arrhenius-type expression $\bar{\tau} = \bar{\tau}^0 \exp(I/kT)$ and taking into account the temperature dependence of the ionization coefficient β, we found the experimental desorption energies (I) to be 2.30 eV for a clean surface and 1.85 eV for a contaminated surface. The corresponding pre-exponential factors ($\bar{\tau}^0$) were found to be 3.24×10^{-14} sec and 2.2×10^{-12} sec, respectively. (auth)

9488 SCATTERING OF H BEAMS FROM A (100) W SURFACE. Hayward, D. O.; Walters, M. R. (Imperial Coll. of Science and Tech., London). Jap. Appl. Phys.; No. Suppl. 2, 587-590(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The angular distribution of hydrogen scattered from a (100) oriented tungsten crystal was measured at room temperature for both the clean surface and the hydrogen-covered surface. Of the molecules incident on the clean surface, 81% were chemisorbed, 16% were scattered diffusely according to the cosine law, and 1% were specularly reflected. The remaining 2% appeared in a secondary peak, the origin of which is not fully understood. Scattering from the hydrogen-covered surface was dominated by an intense specular reflection. Diffraction was also observed and eight first-order diffraction peaks were identified. (auth)

9489 EFFECTS OF ADSORPTION ON THE EFFICIENCY OF ENERGY EXCHANGE BETWEEN GASES AND SOLIDS. Thomas, L. B.; Best, W. V.; Roach, D. V. (Univ. of Missouri, Columbia). Jap. Appl. Phys.; No. Suppl. 2, 595-598(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Intervention of adsorbed films between a bare metal substrate and a contiguous non-adsorbing gas causes readily observable and even spectacular changes in the thermal accommodation coefficient (AC) of the gas on the surface. Methods of measuring such effects and some resulting observations are described. Applications of such observations to gain knowledge of adsorption phenomena are illustrated. Particular attention is given to following the kinetics of adsorption of alkali metals on originally clean and on H_2 covered tungsten. An application of AC observations to determine the heat of sublimation of K is made. A unique case of decreasing AC with increasing coverage is observed during the second half of monolayer formation of alkali metals on tungsten. The effects on the AC such as described provide a wide-open field for theoretical investigation. (auth)

9490 EFFECT OF SURFACE IMPURITIES ON THE THERMAL ACCOMMODATION OF RARE GASES ON A W SURFACE. Roach, D. V. (Univ. of Missouri, Rolla); Biolsi, L. Jr.; Harris, R. E. Jap. Appl. Phys.; No. Suppl. 2, 599-602(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The effect of surface impurities (potassium and cesium) on the thermal accommodation of rare gases on a tungsten surface was examined from a theoretical viewpoint. Particular emphasis was given to the effect on the thermal accommodation of helium on a tungsten surface caused by the adsorption of cesium ions and/or atoms. For this examination, the theory of Allen and Feuer was used with reasonable values of the interaction parameters for helium with the adsorbate as well as the force constant for the adsorbate-substrate bond. Resulting values of the accommodation coefficients are compared with experimental values. (auth)

9491 AUGER AND SECONDARY ELECTRONS EXCITED BY BACKSCATTERED ELECTRONS. Goto, K. (Nagoya Inst. of Tech., Japan); Koshikawa, T.; Shimizu, R.; Ishikawa, K. Jap. Appl. Phys.; No. Suppl. 2, 633-635(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The contribution of backscattered electrons to the Auger and secondary electron yields was examined by in-situ measurements while evaporating Be onto a Cu substrate at constant rate, 1.2 Å/min. The ratios, β_A and β_S, of the Auger (KVV) and secondary yields of Be due to backscattered electrons, to those due to primary electrons, were experimentally obtained from the Auger and true secondary electron yields versus backscattering coefficient η curves, and were evaluated to be ~1.6 and ~4.4 at a primary energy of 1.0 keV, respectively. The backscattering factor r for Be (KVV Auger) was experimentally found to be ~1.1 at a primary energy of 1.0 keV. (auth)

9492 SPIN-POLARIZATION IN LEED. Jennings, P. J. (Univ. of New South Wales, Kensington, Australia). Jap. Appl. Phys.; No. Suppl. 2, 661-665(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The origin of spin-polarization in low energy electron diffraction is reviewed. The density matrix description of spin-dependent scattering is introduced and applied to the measurement of spin-polarization in a Mott analyzer. Theoretical intensity and polarization versus energy curves are presented for LEED from W (001). The results indicate that spin-polarization analysis could enhance the power of LEED for surface structural analysis. (auth)

9493 INFLUENCE OF SURFACE STRUCTURE ON THE AC LOSSES IN SUPERCONDUCTING V. Deprez, E.; Bruynseraede, Y.; Thys, W.; Reynders, L. (Univ. of Leuven, Belgium). Jap. Appl. Phys.; No. Suppl. 2, 719-722(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The response of the superconducting surface sheath of pure vanadium to low frequency (<1 kHz) ac fields of small amplitude (h_0 < 10 Oe), was studied. The effect of different surface treatments, especially of ion implantation on the flux penetration and on the energy dissipation is analyzed. (auth)

9494 PHOTOELECTRIC STUDY OF THE ADSORPTION OF Rb ON W. Hall, T. W.; Mee, C. H. B. (Queen's Univ. of Belfast). Jap. Appl. Phys.; No. Suppl. 2, 741-744(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Work function changes occurring during submonolayer adsorption of rubidium on tungsten substrates were monitored using a photoelectric technique. During adsorption on polycrystalline tungsten, the work function fell rapidly from the clean value to a minimum of $\phi_{min} = 1.70$ eV at $\theta = 0.6$. No subsequent rise in work function was observed. For a (100) tungsten substrate, the work function fell to $\phi_{min} = 1.50$ eV at $\theta = 0.6$ and then rose to $\phi_{final} = 2.05$ eV at $\theta = 1.0$. The values of ϕ_{min} and ϕ_{final}, together with those obtained by other workers for the adsorption of lithium, sodium, potassium and cesium on tungsten, are compared with those predicted theoretically. (auth)

9495 WORK FUNCTION VARIATION OF W IN Sr VAPOR. David, J. P. (Univ., Marseille); Denisot, J. L.; Floret, F.; Kassibrakis, G. Jap. Appl. Phys.; No. Suppl. 2, 745-748(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The electron work function variation of tungsten samples was experimentally studied in a strontium vapor environment: single crystal sample in a thermoelectronic emission microscope, polycrystalline sample in a strontium filled cylindrical diode. The data show the emission current density versus the reciprocal sample temperature T^{-1}, and work function variation versus the ratio T/T_{Sr}, T_{Sr} being the strontium reservoir temperature. Comparison of these results obtained by two methods in different strontium pressure ranges and the study of oxygen influence are of interest for thermionic conversion. (auth)

9496 X-RAY PHOTOELECTRON SPECTROSCOPIC OBSERVATION OF METALS AND Ti–O ALLOY HEATED IN HIGH VACUUM. Hirokawa, K.; Honda, F. (Tohoku Univ., Sendai). Jap. Appl. Phys.; No. Suppl. 2, 783-786(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The change of the core electron binding energies of various metals and alloys by heating at 400°C in a vacuum were observed. Pure metallic surface state of Fe, Ni, Cu, Ti, Zr and Ta metals appeared extensively for heating over 5 hrs. Two plausible mechanisms, chemical reduction process and the diffusion process, were proposed. The X-ray photoelectron spectrum from Ti in Ti–O solid solution alloys changes into various types of spectral patterns during heating. (auth)

9497 STUDY OF SURFACE PROCESSES ON Cu–Be BY COMBINED SECONDARY ION MASS SPECTROMETRY AND AUGER ELECTRON SPECTROSCOPY. Buhl, R.; Huber, W. K.; Loebach, E. (Balzers Aktiengesellschaft fuer Hochvakuumtechnik und Duenne Schichten, Liechtenstein). Jap. Appl. Phys.; No. Suppl. 2, 807-810(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Secondary ion mass spectrometry and Auger electron spectrometry are combined to investigate surface processes on copper-beryllium during heat treatment and oxidation. Using low energy Auger peaks, data are obtained that can be related to SIMS results concerning information depth and chemical binding. It is shown that a copper-beryllium surface undergoes major changes during bake-out. (auth)

9498 ADSORPTION OF O ON W(100): A LEED, XPS, AND UPS STUDY. Bradshaw, A. M.; Menzel, D.; Steinkilberg, M. (Univ., Munich). Jap. Appl. Phys.; No. Suppl. 2, 841-846(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Using a combination of ultrahigh vacuum instruments it was possible to apply the techniques of LEED, XPS and UPS (x-ray and ultraviolet photoelectron spectroscopies) in situ to the same sample. The oxygen/W(100) system was chosen as model. The results from the three methods are correlated with each other and compared to electron impact desorption data. (auth)

9499 EFFECT OF ADATOM–ADATOM INTERACTION ON THE ADSORPTION STATE. Muda, Y. (Nara Univ. of Education, Japan); Hanawa, T. Jap. Appl. Phys.; No. Suppl. 2, 867-870(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Taking into account the hopping and exchange interactions between adatoms within a model analogous to the Anderson model, the local density of states at adatom site calculated for the H/W(100) system, and assignment is made to the FEED (field emission energy distribution) peaks for this system observed by Plummer and Bell. The double peaks ~1 eV below ϵ_F for the β_2 state of H adatom and the dispersed peaks for the β_1 state can be assigned to the virtual bound states of nonmagnetic and ferromagnetic H adatoms, respectively. The present calculation agrees with the speculation that both β_2 and β_1 are atomic adsorbed states. (auth)

9500 STUDY OF SURFACE SELF-DIFFUSION BY MEASURING PROFILE CHANGES OF FIELD EMITTER TIPS (W). Piquet, A.; Roux, H.; Binh, V. T.; Uzan, R.; Drechsler, M. (Univ. Claude Bernard, Lyon). Jap. Appl. Phys.; No. Suppl. 2, 909(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

If a conical metal tip is heated in ultra-high-vacuum, the curvature radius at the apex increases continuously. A measurement of this phenomenon permits a determination of the surface self-diffusion coefficient using Herring's equation and the numerical data of Nichols and Mullins. The increase of the curvature radius at the apex is determined in situ by measuring the field electron current as a function of voltage and the final radius and profile are determined by scanning electron microscopy. The logarithm of the surface-self-diffusion coefficient of tungsten (without an adsorbed layer) versus the reciprocal temperatures varies linearly in the experimental region ($D = 3.2 \cdot 10^{-3}$ cm^2/sec at 2100K and $D = 3.6 \cdot 10^{-5}$ cm^2/sec at 2900 K). As activation energy a value of 3.08 eV/atom is found. (auth)

9501 QUASIEQUILIBRIUM TREATMENT OF THE COVERAGE OF O ON W AT HIGH TEMPERATURE AND LOW PRESSURE. Dabiri, A. E. (Arya–Mehr Univ., Tehran, Iran). Jap. Appl. Phys.; No. Suppl. 2, A-910(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The quasiequilibrium treatment of heterogeneous reactions and first order desorption kinetics are combined to formulate a model of the equilibrium coverage of oxygen on tungsten at high temperatures ($1200 < T < 2500$K) and low oxygen partial pressures ($10^{-9} \leq P_{O_2} \leq 10^{-5}$ Torr). The results are compared with existing data and the agreement is fairly good in view of the extreme simplicity of the theoretical model. (auth)

9502 ESCA STUDY OF Xe ADSORBED ON THE W(111) PLANE. Yates, J. T. Jr.; Erickson, N. E. (National Bureau of Standards, Washington, DC). Jap. Appl. Phys.; No. Suppl. 2, A-910(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

An ultrahigh vacuum ESCA spectrometer was used to study the adsorption of Xe on a W(111) single crystal disk at ~100 K. The photoelectron spectrum of Xe is compared with flash desorption energy. The ESCA measurement has a limiting sensitivity of ~0.05 monolayer of Xe, and involves digital summation of multiple scans. As Xe coverage increases in the range $0.05 \leq \theta_{Xe} \leq 1.0$, the Xe ($3d_{\frac{5}{2}}$) level is shifted monotonically upward in binding energy by 0.5 ± 0.1 eV, relative to the Fermi level of W(111). Part of this shift may be due to preferential Xe adsorption on extraneous sites other than W(111), the remainder being related to weak interactional effects between Xe molecules on W(111). Above $\theta_{Xe} \cong 0.2$ the desorption energy of Xe is constant on this W(111) crystal. (auth)

9503 He DIFFRACTION FROM W(112). Stoll, A. G. Jr.; Merrill, R. P. (Univ. of California, Berkeley). Jap. Appl. Phys.; No. Suppl. 2, A-918(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

A study was made of helium diffraction from the (112) face of tungsten. The positions of the ($\bar{1}0$) and (10) beams are shown to follow the Bragg relation for incident angles from 20° to 70°, and the relative intensities of the diffraction beams to the specular beam are in agreement with simple diffraction theory. Debye-Waller analysis of the thermal attenuation of the specular scattering leads to unrealistically high values of the surface Debye temperature, while electron scattering from the same surface gives Debye temperatures of 1/2 to 2/3 the bulk. Neon scattering in the ($1\bar{1}0$) direction gives rainbow scattering, while argon is scattered in a single pseudo-specular lobe. Attempts to deduce interaction energies from measurements of selective helium adsorption are also described. (auth)

9504 LOW-FREQUENCY NOISE IN TIN FILMS AT THE SUPERCONDUCTING TRANSITION. Clarke, J.; Hsiang, T.Y. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. Lett. 34: No. 19, 1217-1220 (12 May 1975).

The $1/f$ noise spectra of current-biased tin films on glass substrates at the superconducting transition were in quantitative agreement with the semiempirical formula of Clarke and Voss. Tin films with an aluminum underlay to reduce the thermal boundary resistance between film and substrate had spectra that were flat at low frequencies. Spatial correlation of the noise was observed in both types of samples. (auth)

9505 FLUCTUATION SCATTERING OF MAGNETIC EXCITATIONS IN A NEARLY CRITICAL SINGLET-GROUND-STATE SYSTEM: DOUBLE-hcp Pr. Bak, P. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. Lett. 34: No. 19, 1230-1234 (12 May 1975).

The temperature dependence of the magnetic-excitation spectrum in a singlet-doublet system is calculated by use of a generalized Vaks-Larkin-Pikin diagram technique. The first-order terms in the high-density expansion representing scattering on single-site fluctuations give an almost complete description of the line shapes in double-hcp praseodymium at any temperature. (auth)

9506 NATURE OF THE $5f$ ELECTRONS IN THE ACTINIDE SERIES. Johansson, B. (FOA He2, Stockholm 80, Sweden). Phys. Rev. B 11: No. 8, 2740-2743 (15 Apr 1975).

The nature of the $5f$ electrons in the actinide metals is discussed within the framework of the Hubbard model. Thereby, good evidence for itinerant $5f$ states is found for the lighter actinides (plutonium or lighter). This supports the picture that has recently emerged from energy-band calculations. (auth)

9507 GENERALIZED PHASE DIAGRAM FOR THE RARE-EARTH ELEMENTS: CALCULATIONS AND CORRELATIONS OF BULK PROPERTIES. Johansson, B. (Department of Physics, FOA, HE 2, S-104 50 Stockholm 80, Sweden); Rosengren, A. Phys. Rev. B 11: No. 8, 2836-2857 (15 Apr 1975).

A "generalized" phase diagram is constructed empirically for the lanthanides. This diagram makes it possible, not only in one picture, to assemble a lot of information but also to predict phase transitions not yet experimentally accessible. Further, it clearly illustrates the close relation between the members of the lanthanide group. To account for some of its features, the pseudopotential method is applied. The trend in crystal structure through the lanthanide series can thereby be qualitatively accounted for, as can the trend in crystal structure for an individual element, when compressed. A scaling procedure makes it possible to extend our treatment to elements neighboring the lanthanides in the Periodic Table. In total 25 elements are considered. An atomic parameter f (relatable to the pseudopotential) is introduced, by means of which different phase transitions, both for an individual rare-earth element and intra-rare-earth alloys, can be correlated to certain critical values of this parameter. A nonmagnetic rare-earth series (Sc, Lu, Y, La, and Ac) is introduced and the occurrence of superconductivity is discussed with special emphasis on the pressure dependence of the transition temperature. This temperature can be correlated to the above-mentioned parameter f, both for intra-rare-earth alloys and pure elements at different pressures. The found correlation implies that actinium is a superconductor with a critical temperature which could be as high as (11–12) °K. It is also argued that the actinide series can be viewed upon as a second delayed rare-earth series. From this, several analogies between the two series are pointed out, which might throw new light upon several problems concerning the rare-earth themselves, e.g., the nature of the γ-α transition in cerium and the occurrence of the dhcp structure in the light lanthanides. Finally, valence transitions at high pressure for europium and ytterbium are discussed. Calculations give that these elements should become trivalent at a pressure range of the order of 100–150 kbar. (auth)

9508 STRUCTURE AND PROPERTIES OF Nb_3SnH_x. . Vieland, L.J.; Wicklund, A.W. (RCA Laboratories, Princeton, New Jersey 08540); White, J.G. Phys. Rev. B 11: No. 9, 3311-3316 (1 May 1975).

The effect of alloying H with Nb_3Sn has been studied as a function of composition out to Nb_3SnH. Superconductive transition temperatures and lattice constants of the β-W phase were measured over the entire range, and the absence of the low-temperature cubic-tetragonal lattice transformation confirmed for $x > 0.1$. T_c falls to below 4.2 °K at $x \sim 1$ in a manner resembling that for Sb doping, and the rigid-band-approximation implications of this similarity are briefly discussed. Neutron diffraction reveals that the H atoms lie at the alternative Nb

positions of the β-W lattice, cross linking orthogonal Nb chains. The low-temperature specific heat of lightly hydrided Nb_3Sn is strikingly different than for the same sample with the H removed, the density of states being higher, but the normal-state specific heat lower. This difference is related, through x-ray measurements of a temperature-dependent tetragonal strain near T_c in pure single-crystal Nb_3Sn, to the martensitic transformation. (auth)

9509 CALORIMETRIC DETERMINATION OF THE ELECTRON-PHONON MASS ENHANCEMENT OF α-URANIUM
Bader, S.D.; Knapp, G.S. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. B 11: No. 9, 3348-3353 (1 May 1975).

A conduction-electron mass enhancement λ for the 2-K superconducting α phase of uranium was obtained from a comparison of the linear coefficient of the electronic heat capacity at high temperature, γ_h, with that at low temperature, γ_0. A λ of 0.9 ± 0.2 was found. The γ_0 value used was obtained in a high-pressure experiment reported in the literature. The γ_h value was extracted from published heat-capacity measurements below 500 K by adjustment of the data to the volume of the low-temperature experiment, subtraction of an appropriate Debye function, correcting for anharmonicity, and graphically fitting the resultant electronic contribution. The uncertainty in λ is dominated by the uncertainty in the characterization of the constant-volume lattice anharmonicity, which was estimated using Wallace's recent empirical correlation based on Grüneisen constants. Using the observed magnitude of λ and T_c, McMillan's equation for the superconducting transition temperature indicates that large Cooper-pair-weakening interactions are probably present in α-uranium. It is known that the γ_0 value of the 2-K superconducting α phase of uranium is ~30% higher than the γ_0 value of the lower-T_c single-crystal uranium at zero pressure. A combined analysis of the electronic heat capacity and magnetic susceptibility below room temperature indicates that the different values of γ_0 reflect not only changes in the unenhanced electronic density of states at the Fermi energy, but also substantial changes in λ. Furthermore, the low-pressure depression of T_c relative to the α-phase T_c value of 2 K is in large part due to a depression in λ. (auth)

9510 INDUCTIVE TRANSITION OF NIOBIUM AND TANTALUM IN THE 10-MHz RANGE. II. THE PEAK IN THE INDUCTIVE SKIN DEPTH FOR T JUST LESS THAN T_c.
Varmazis, C. (Columbia University, New York, New York 10027); Hook, J.R.; Sandiford, D.J.; Strongin, M. Phys. Rev. B 11: No. 9, 3354-3361 (1 May 1975).

In the region of temperature just below the superconducting transition temperature T_c, where the inductive skin depth δ_i is less than the dc penetration depth, a peak was observed in δ_i as a function of temperature in some Ta and Nb specimens. The Mattis-Bardeen theory of the surface impedance of superconductors is used to investigate the occurrence of such peaks. In order to explain quantitatively the experimental results, it is necessary to take into account the effect of impurities near the sample surface. This is done by changing the boundary condition on the order parameter at the sample surface. The necessary change is similar in magnitude to that needed to explain the penetration-depth measurements presented in a previous paper. (auth)

9511 TRANSVERSE ELECTROMAGNETIC RESPONSE IN SUPERCONDUCTORS BY ACOUSTIC TECHNIQUES. I. ANOMALIES IN THE ELECTROMAGNETIC RESPONSE IN NIOBIUM. Leibowitz, J.R. (Catholic University, Washington, D.C. 20064); Francavilla, T.L.; Alexander, E.M. Phys. Rev. B 11: No. 9, 3362-3373 (1 May 1975).

The work reported here had as its purpose the study of the transverse *electromagnetic* response as a function of $\vec{q}$ in high-purity niobium by observing the attenuation of transverse acoustic waves near T_c in the high-ql regime. The associated contribution to the acoustic attenuation, the electromagnetic attenuation α_E, is expected to suffer a rapid decrease below T_c when $ql > 1$, reflecting the rise of the conductivity in the superconducting state; the remaining electronic contributions to the attenuation, comprising the so-called residual attenuation α_R, are expected to satisfy the more gradual temperature dependence predicted by Bardeen, Cooper, and Schrieffer for so-called case I absorption. Despite the fact that the measurements were made in single-crystal niobium having resistivity ratio of 5000 at frequencies to 450 MHz, corresponding to $ql \simeq 20$ at T_c, the "rapid-fall" region was not in evidence in Nb either for $\vec{q} \| [100]$ or for $\vec{q} \| [110]$ and $\vec{\epsilon} \| [1\bar{1}0]$. The absence for given $\vec{q}$ and $\vec{\epsilon}$ of the so-called rapid-fall regime in niobium, which we first reported in 1971, represents the first known example of such behavior. The present paper, addressed primarily to the inevitable skepticism which ensued, confines itself to a detailed documentation of the evidence for absence of rapid fall in niobium. It is demonstrated that on the basis of present theory the absence of rapid fall in Nb cannot be attributed to high-frequency breakdown of electromagnetic screening. (auth)

9512 EFFECT OF OXYGEN, NITROGEN, AND HYDROGEN ON THE MECHANICAL PROPERTIES OF Nb-752. Mahoney, W. M.; Paton, N. E. J. Eng. Mater. Technol.; 96: No. 3, 201-206(Jul 1974).

Uniaxial tensile properties of the Nb-base alloy Nb-752 were determined as a function of O, N and H content from −196 to 200°C. Each of these impurities increased the temperature at which a ductile-brittle transition occurs. Although ductility was severely reduced, strength parameters were relatively unchanged, making detection of embrittlement by hardness testing difficult. Impurity levels for embrittlement were sufficiently low and the affinity of Nb-752 for contamination sufficiently great that processing operations require strict control. The mechanism of this impurity embrittlement is not well understood. However, observations of fracture surfaces of brittle failures reveal mixed intergranular cleavage with a uniform distribution of precipitates throughout grain boundaries. These observations are discussed in the light of current theories. (Metals Abstr.)

9513 INFLUENCE OF CARBON ON THE LAYER FORMATION DURING INTERDIFFUSION OF MOLYBDENUM AND IRON. Heijwegen, C. P.; Rieck, G. D. Met. Sci. J.; 8: No. 11, 383-386 (Nov 1974).

Experiments were carried out between 800 and 1300°C with diffusion couples prepared from Fe containing 0.09 wt.-% C and pure Mo. At all annealing temperatures, an η carbide, Mo_3Fe_3C, is formed with a very narrow homogeneity range, ~3 at.-% Fe. The formation of the carbide is very fast, but stops at a certain layer thickness. During heating at temperatures from 800 to 1000°C, a two-phase layer is also formed, probably consisting of Mo_2C and the η carbide. The solid-solution layer of Mo in Fe grows parabolically above 1000°C. Below 1000°C it reaches the equilibrium concentration only after the disappearance of the two-phase layer. The diffusion behavior in this system is compared with results obtained in the Mo−Ni−C system. (Metals Abstr.)

9514 KINETICS OF THE NITRIDING OF NIOBIUM. Samsonov, G. V.; Kaplina, G. S. Zashch. Pokrytiya Metal.; No. 4, 101-107(1971). (In Russian).

The reactive diffusion of N into Nb was studied by a radioisotope method, the results being correlated with X-ray microanalysis. The kinetic characteristics of the nitriding of Nb were analyzed. The growth of the nitrided layer obeyed a parabolic time law and was limited by the diffusion of N through the reaction products. The phase composition of the coating incorporated two phases, NbN and Nb_2N, and under these was an α solid solution of N in Nb. (Metals Abstr.)

9515 ANISOTROPY OF STRUCTURAL ELEMENTS IN DEFORMED REFRACTORY METALS. Ivashchenko, R. K.; Mil'man, Yu. V.; Trefilov, V. I.; Khomenko, G. E. (Inst. of Problems in Material Science, Kiev). Fiz. Metal. Metalloved.; 39: No. 1, 81-87(Jan 1975). (In Russian).

It is shown that on deformation of tungsten alloyed with 0.1% Ti there is formed not only a band grain structure, but also a band cell structure. The anisotropy of the grain structure is satisfactorily described by the Taylor−Polyani principle, but the anisotropy of the cell structure is determined both by the change in form during deformation and by polygonization processes. The cell boundaries in the deformed metal ordinarily lie in one plane, and this behavior promotes the propagation of cracks along the subgrains. (SJR)

9516 EFFECTS OF ENVIRONMENT ON METAL FATIGUE. Snowden, K. U. (Australian Atomic Energy Commission, Sutherland). pp 170-178 of Effects of Chemical Environment on Fracture processes. Melbourne; Univ. of Melbourne (1974).

From 3rd Tewksbury symposium on effects of chemical environment on fracture processes; Melbourne, Australia (4 Jun 1974).

Studies of the mechanism of the effect of gaseous environments on the fatigue behavior of metals at low and elevated temperatures are briefly reviewed. The dependence of fatigue life on gas pressure is generally found to be S-shaped. The available data on the influence of temperature on S-shaped fatigue life vs pressure curves are examined, and the mechanisms are discussed. Recent data on Ni and new results on Zr suggest that the effect of environment on fatigue life may be explained by a mechanism involving the restriction of gas transport to the crack tip by the formation of oxide along crack faces. (auth)

9517 DEVELOPMENT OF HARD SUPERCONDUCTORS. Hillmann, H. (Vacuumschmelze G.m.b.H., Hanau (F. R. Germany)). Z. Metallkd.; 66: No. 2, 69-73(1975). (In German).

From general meeting of the Deutsche Gesellschaft fuer Metallkunde; Bonn, F. R. Germany (5 Jun 1974). 14 figs.; 9 refs.

Physical and technological problems and their solutions in the development of hard superconductors for technical application are reported. (GE)

9518 ANOMALOUS THERMOELECTRIC POWER OF RARE EARTH METALS AND THEIR COMPOUNDS. Takayama, H.;

Fulde, P. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (F. R. Germany)). Z. Phys., B.; 20: No. 1, 81-87(1975).

A new mechanism is proposed for an anomalous thermoelectric power (ATP) in the paramagnetic state of certain rare earth metals and their compounds, in which the ions possess a non-magnetic ground state in a given crystal field. The ATP is found to be due to higher order inelastic scattering (second Born approximation) of the conduction electrons by the crystal field split rare earth ions. It has a peak at a temperature $\Delta/3$ and approximately $\Delta/2$, where Δ is the splitting energy between the ground state and the first excited state. The main result is that the appearance of an ATP requires interactions between the conduction electrons and the ions of other than the simple isotropic exchange type. This implies that the ATP may serve as a valuable tool to detect more complicated types of the k-f interaction than the isotropic exchange. (auth)

9519 ELECTRON MICROSCOPY STUDIES OF THE MICROSTRUCTURE OF RCo_5 MAGNETS (R = RARE EARTHS). Pfeiffer, I. (Vacuumschmelze G.m.b.H., Hanau (F. R. Germany)). Z. Metallkd.; 66: No. 2, 93-97(1975). (In German).

A transformation hexagonal → rhombohedral is indicated in the Sm_2Co_7 phase of $SmCo_5$ magnets which is characterized by an intensive stacking fault formation parallel to the hexagonal basal planes. The stacking fault formation observed after heat treatment in the RCo_5 phase of (MM)Co_5 and (MM,La)Co_5 magnets is associated with the tendency of the hyperstoichiometric RCo_5 lattice to release excess rare earths atoms because stacking fault formation may be the first stage in passing from the RCo_5 to the R-richer R_2Co_7 or R_2Co_{19} structure. There is some evidence that on certain conditions preliminary stages of R_2Co_7 or R_2Co_{19} are already present in a two-dimensional form on stacking faults. The observed lattice defects are seen in indirect connection with the decrease of Hsub(c) after 700 to 800°C heat treatment assuming their formation going parallel with the removal of excess rare earths atoms which may cause changes in the Hsub(c) determining factors as magneto-crystalline anisotropy and point defect concentration of the matrix. (GE)

9520 DETERMINATION OF THE SOLUBILITY OF NITROGEN IN LIQUID MOLYBDENUM. Domke, H.; Frohberg, M. G. (Technische Univ. Berlin (F. R. Germany). Abt. Allgemeine Metallurgie). Z. Metallkd.;65: No. 9, 615-617(Sep 1974). (In German).

4 figs.; 1 tab.; 15 refs. Part of a thesis by H. Domke.

A 400 kHz - high vacuum - levitation melting furnace was used to determine the solubility of nitrogen in liquid molybdenum at 2,650°C. It is given by wt. % [N] sub (Mo) = 0.132 psub(N2)sup ($\frac{1}{2}$) up to psub (N2) = 0.65 atm. Sievert's law is obeyed. (auth)

9521 DIFFUSION IN THE TERNARY SYSTEM TITANIUM-VANADIUM-ZIRCONIUM AT 800°C. II. Quantitative Treatment. Brunsch, A.; Steeb, S. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany). Inst. fuer Werkstoffwissenschaften). Z. Metallkd.; 65: No. 12, 765-773(Dec 1974). (In German).

10 figs.;2 tabs.; 18 refs. Part of a thesis by A. Brunsch.

The time dependency of growth of diffusion zone was investigated in ternary diffusion specimens. The four coefficients of interdiffusion calculated for 58 different concentrations are given together with their concentration dependency. By extrapolation the tracer coefficients D^0sub(V) (Ti,Zr) and D^0sub(Zr) (Ti,V) were obtained. At the critical point of the two phase region (β + delta) in the isothermal section the D-matrix becomes unlike zero. The Onsager relation for the coefficients of interdiffusion is only valid in part of the whole concentration range. The deviations in distinct concentration regions give conclusions concerning ideality of ternary solid solubility. Zirconium shows the largest diffusion coefficient in contradiction to the fact that the atomic volume is larger than that of vanadium or titanium. (auth)

9522 PHASE EQUILIBRIA IN THE SILVER-LANTHANUM SYSTEM. Delfino, S.; Ferro, R.; Capelli, R.; Borsese, A. (Genoa Univ. (Italy). Instituto di Chimica Generale ed Inorganica 1; Genoa Univ. (Italy). Instituto di Chimica Generale ed Inorganica 2). Z. Metallkd,; 65: No. 12, 781-783(Dec 1974).

The silver-lanthanum system was studied by differential-thermal, metallographic, X-ray and chemical analyses. The following phases were observed: Ag_5La (peritectic formation at 825 +- 5°C), approximately $Ag_{51}La_{14}$ (m.p. 1,000 +- 10°C), Ag_2La (peritectic formation at 860 +- 10°C), and AgLa (m.p. 880 +- 10°C). Three eutectics occur: Ag-Ag_5La (795 +- 5°C, 10.0 +- 0.3 at.% La), Ag_2La-AgLa (880 +- 5°C, 43.0 +- 0.5 at.% La) and AgLa-La (535 +- 5°C, 76.5 +- 0.5 at.% La). (auth)

9523 W-Cr-Ni SINTER ALLOYS. Jangg, G. (Inst. for Chemical Tech., Vienna); Kieffer, R.; Retelsdorf, H. J.; Dufek, P. Planseeber. Pulvermet.; 22: No. 1, 3-14(Mar 1974). (In German).

W-Cr-Ni alloys produced powdermetallurgically under 30 atm inert gas pressure by liquid phase sintering, i.e., at temperatures, at which some liquid eutectic appears, and to avoid chromium evaporation which gives rise to a high degree of microporosity, have been tested and found to have good high-temperature properties. At tungsten-contents under 30%, the alloys are corrosion resistant. These alloys appear to be at least equal to the modern superalloys. (auth)

9524 RECRYSTALLIZATION OF B-CONTAINING Mo ALLOYS. Benesovsky, F.; Tiles, B. (Metallwerk Plansee A. G., Reutte, Austria). Planseeber. Pulvermet.; 22: No. 1, 29-40 (Mar 1974). (In German).

Sintered molybdenum alloys with 5 to 800 ppM boron were examined for hardness and recrystallization behavior as a function of the type and degree of deformation (swaging, rolling, or drawing). Microalloying additions of boron in molybdenum have a grain-refining and hardening effect. The temperature range of complete recrystallization is increased to about 1300° C, whereas for pure molybdenum this temperature, is about 1100° C. Above this temperature in boron alloyed molybdenum slow grain growth takes place, which, however, is not accelerated by critical deformation to the same degree as in pure molybdenum. Wire of boron-doped molybdenum exhibits directional grain growth (Non-Sag structure). Since this phenomenon in tungsten is caused by submicroscopic gas bubbles, the assumption is justified that the favorable properties of boron-alloyed molybdenum are due, not so much to solid dispersion, but to a different effect of these gas bubbles. (auth)

9525 TUNGSTEN-HEAVY METAL ALLOYS. Jangg, G. (Inst. for Chemical Tech., Vienna); Kieffer, R.; Childeric, B.; Ertl, E. Planseeber. Pulvermet.; 22: No. 1, 15-28(Mar 1974). (In German).

Studies on tungsten heavy metal alloys with cobalt-iron-nickel binder showed that a small cobalt addition has a positive effect on the ductility and hardness; the favorable influence on the ductility is greater than that on the hardness decrease. At binder metal compositions of about 5 Ni, 3 Co, 2 Fe, an optimum compromise between hardness and elongation is attained. The studies have also shown that further improvements are possible by a suitable choice of sintering temperatures and sintering times. The sintering temperature should only be high enough to provide sufficient liquid phase during sintering. The sintering time should not exceed 30 to 60 minutes. Longer sintering, particularly at excessively high temperatures, causes an undesirable grain growth in the tungsten grains within the heavy metal structure which reduces the elongation. (As value the torsion rupture angle on rods is measured.) (auth)

9526 SINTERED MATERIALS OF K-Si DOPED Mo AND PROPERTIES OF THE FINISHED PRODUCT. Eck, R. (Metallwerk Plansee A. G., Reutte, Austria). Planseeber. Pulvermet.; 22: No. 3, 165-174(Sep 1974). (In German).

A description of the technical molybdenum alloys is given. The silicon and oxygen loss of potassium-silicon-doped molybdenum under different sintering conditions is discussed. On the basis of scanning electron micrographs and microprobe measurements, the potassium and silicon distribution and the bubble formation in molybdenum with overlapping crystal structure in sintered and wrought rods are treated in detail. The recrystallization behavior of potassium-silicon-doped molybdenum wire is compared with that of Mo, TZM and Mo 0,05 Co on the basis of tensile tests as a function of the annealing temperature. (auth)

9527 GROWTH MODEL FOR THE RECRYSTALLIZATION BEHAVIOR OF DOPED TUNGSTEN WIRE. Thompson-Russell, K. C. (Metaallaboratorium, Maarheeze, Netherlands). Planseeber. Pulvermet.; 22: No. 3, 155-164(Sep 1974).

A step-wise growth mechanism has been suggested for the recrystallization reaction which results in the development of elongated recrystallized grains having a [531]-type wire texture. The two requirements for this reaction are (1) small second phase bubbles or particles, dispersed in rows and (2) a very large stored energy due to the preceding deformation. This phenomenon has also been observed in doped-molybdenum and W-1.5wt% ThO_2. (auth)

9528 FIELD-ION MICROSCOPY OF URANIUM IN A CONTINUOUS FIELD EVAPORATION REGIME. Suvorov, A. L.; Kukavadze, G. M.; Skorov, D. M.; Bobkov, A. F.; Kuznetsov, B. Ya.; Kalin, B. A.; Volkov, V. B. Zaitsev, S. V. At. Energ. (USSR); 38: No. 2, 72-77(Feb 1975). (In Russian).

Results of a field-ion microscopy investigation of the kinetics of continuous field evaporation of uranium at a temperature of 78° K are presented. The value of evaporating field is assessed and the most probable type of evaporated ions predicted. On the

basis of existing theories of the process, its sensitivity is determined and certain parameters are calculated. (4 figures, 2 tables, 18 references.) (auth)

9529 INFILTRATION OF W WITH Cu AND Ag. Stolarz, S. (Inst. fuer Nichteisenmetalle, Gliwice, Poland). Planseeber. Pulvermet.; 22: No. 3, 188-209(Sep 1974). (In German).

A survey is given on the research carried out in the Nonferrous Metals Institute at Gliwice in the field of tungsten infiltration with copper, silver, and copperalloys. The specimens were either dipped in the molten metal or solid infiltrant was placed on top of the skeletons. The infiltration was carried out in hydrogen and under vacuum. The effect of tungsten grain size, pressure, sintering temperature, and infiltration time on the density, porosity, hardness, electrical conductivity, and erosion of the tungsten–copper, tungsten–silver and tungsten–copper-nickel materials was examined. (auth)

9530 SPECIFIC HEAT OF THE SPIN-FLUCTUATION SYSTEM UAl_2. Trainor, R.J.; Brodsky, M.B.; Culbert, H.V. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 34: No. 16, 1019-1022 (21 Apr 1975).

We report measurements of the specific heat of paramagnetic UAl_2 between 0.8 and 25 K in magnetic fields up to 43 kOe. A nearly field-independent $T^3 \ln T$ term dominates the temperature region below 10 K. The susceptibility was measured between 3 and 10 K and varies as $1-AT^2$. These results, and earlier resistivity measurements, are consistent with the predictions of the spin-fluctuation model. This is the first unambiguous observation of the specific heat predicted by the spin-fluctuation model for an atomically ordered paramagnet. (auth)

9531 ELECTRON-SPIN POLARIZATION IN LOW-ENERGY ELECTRON DIFFRACTION FROM TUNGSTEN (001). O'Neill, M.R.; Kalisvaart, M.; Dunning, F.B.; Walters, G.K. (Department of Physics, Rice University, Houston, Texas 77001). Phys. Rev. Lett. 34: No. 18, 1167-1170 (5 May 1975).

Electron-spin polarization has been observed in low-energy electron diffraction from a clean tungsten (001) surface. Preliminary studies of the 01 beam at normal incidence and the 00 beam at incidence angles in the range 11° to 20° show significant spin polarization for electron energies from 45 to 190 eV. The polarization is sensitive to both the energy and the incidence angle of the unpolarized primary electron beam and ranges from −35% to +37%. (auth)

9532 PROGNOSIS OF BINARY SIGMA PHASES WITH THE HELP OF A COMPUTER. Savitskii, E. M.; Gribulya, V. B. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 220: No. 5, 1066-1069(11 Feb 1975). (In Russian).

This study deals with forecasting the occurrence of sigma phases by computer from values of the electron structure of atoms. The sigma phase has a tetragonal structure with 30 atoms in the elementary cell. As a rule, in a binary sigma-phase one of the components crystallizes in a body-centered cubic (bcc) structure, and the other in a face-centered cubic (fcc) or hexagonal dense-packed (hdp). In the elementary cell of a sigma-phase, there are 5 non-equivalent positions for the arrangement of 30 atoms. The atoms are arranged in layers, and the structure has a great resemblance to a hexagonal dense-packed with a number of atoms shifted from the basal planes to intermediate positions between the layers. A total number of 174 sigma phases are forecasted in various binary systems on the basis of data on the distribution of electrons in atoms of chemical elements forming these systems. Data on 34 systems having a sigma phase were used as initial data. Data from 29 systems were used as controls to estimate the results of the prognoses. There were no errors in forecasting the sigma-phase in these control systems. Sigma phases do not form with rare earth elements. Of the actinides only thorium participates in the formation of sigma phases. The behavior of the d-zones of the corresponding elements is determining in the formation of sigma phases. This behavior is related to the energy state of the inner electrons. Each indicator of a sigma phase, along with the d-states, includes various electron groups. The electron structure of the atom as a whole must be taken into account. (SJR)

9533 CRYSTAL FIELD PARAMETERS AND PHASE TRANSITIONS IN ErSb. Shapiro, S. M.; Bak, P. (Danish Atomic Energy Commission, Roscoe). J. Phys. Chem. Solids; 36: No. 6, 579-581(Jun 1975).

The crystal field levels of the Er(J = 15/2)ion in a single crystal of ErSb have been measured by inelastic neutron scattering. The crystal field parameters obtained by a least squares fit to the spectra at several temperatures are: $B_4 = (0.473 \pm 0.005) \times 10^{-2}$°K and $B_6 = (0.59 \pm 0.06) \times 10^{-5}$°K, which differ considerably from the values obtained by interpolation from measurements on other compounds. In addition, the temperature dependence of the magnetic scattering in the vicinity of the Néel temperature ($T_N = 3 \cdot 55$°K) clearly demonstrates that the transition is second order in contrast to the first order behavior suggested by specific heat measurements. Also, any lattice distortion accompanying the magnetic ordering is less than 0.1%, the resolution of the present experiment. (auth)

9534 EXPERIMENTAL STUDY OF THE SURFACE SUPERCONDUCTIVITY OF THE ALLOY Ti–22 AT. % Nb. Vasil'ev, N. G.; Karasik, V. R.; Mal'tsev, V. A.; Serefov, A. S.; Cherkasov, N. A. pp 71-75 of Alloys of Rare Metals With Special Physical Properties. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

This is a study of the surface conductivity of a model alloy with a rigidly pinned Abrikosov flux-thread array in the bulk. The experimental dependence of the critical current of the surface superconductivity on the external magnetic field is compared with the theoretical dependence for the alloy Ti-22 at. % Nb, and a study is made of the effect of the surface state on the critical current. The absence of an effect of surface treatment on two critical fields is demonstrated. (IAA)

9535 STUDY OF THE CROSS-SECTIONAL HOMOGENEITY OF THE PROPERTIES OF A SUPERCONDUCTING WIRE. Goncharov, I. N.; Pashkov, P. P.; Potapov, N. N.; Titov, V. S.; Fridman, A. A.; Khukhareva, I. S. pp 78-82 of Alloys of Rare Metals with Special Physical Properties. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The problem of monitoring the homogeneity of the properties of thin superconducting wires in the radial direction is considered. Results of measurements of microhardness, thermal emf, and composition distribution over the cross section of a wire made of Nb-75% Zr alloy with a 0.29-mm diameter, obtained with the aid of an x-ray microanalyzer, are presented together with the results of electron-microscopic and radiographic studies of the wire. A comparison is made between the results of measurements of the superconducting properties of the central and peripheral regions of the same wire. Conclusions are made concerning the optimal procedure for monitoring the cross-sectional homogeneity of the properties of wires. (IAA)

9536 SPECIAL FEATURES OF THE ELECTRICAL RESISTANCE OF TITANIUM, ZIRCONIUM, AND HAFNIUM. Bykov, V. N.; Rudnev, I. I.; Solov'ev, V. A. pp 156-158 of Alloys of Rare Metals with Special Physical Properties. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Results are given of a study of the electrical conductivity of titanium, zirconium, and hafnium in the temperature range from 0 to 1200°C. On the basis of calculations of the temperature dependence of the electrical resistance of these metals, using a two-band model in conjunction with the values of the Hall constant of these metals, it is found that the conductivity occurring in them is realized by both electron and hole carriers. (IAA)

9537 SUPERCONDUCTING TRANSITION IN ZIRCONIUM-RICH ZIRCONIUM–MOLYBDENUM–NIOBIUM TERNARY SOLID SOLUTIONS. Bychkov, I. F.; Mal'tsev, V. A.; Cherkasov, N. A.; Vasil'ev, N. G. pp 41-44 of Alloys of Rare Metals with Special Physical Properties. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

9538 THERMOELECTRIC PROPERTIES OF VANADIUM ALLOYS CONTAINING ELEMENTS OF GROUPS IV–V. Druzhinina, I. P.; Vladimirskaia, T. M.; Fraktovnikova, A. A.; Gushchin, G. I. pp 166-170 of Alloys of Rare Metals with Special Physical Properties. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

9539 COEFFICIENTS OF THERMAL EXPANSION OF SUPERCONDUCTING NIOBIUM–ZIRCONIUM–TITANIUM AND NIOBIUM–TITANIUM ALLOYS IN THE TEMPERATURE RANGE FROM 10 TO 300 K. Golik, V. R.; Petrenko, N. S.; Popov, V. P. pp 39-41 of Alloys of Rare Metals with Special Physical Properties. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Coefficients of thermal expansion of superconducting niobium–zirconium–titanium and niobium–titanium alloys in the temperature range from 10 to 300 K (Koeffitsienty teplovogo rasshireniia sverkhprovodiashchikh splavov niobii-tsirkonii-titan i niobii-titan v intervale temperatur 10-300 K). V. R. Golik, N. S. Petrenko, and V. P. Popov. In: Alloys of rare metals with special physical properties. (A75-12376 02-26) Moscow, Izdatel'stvo Nauka, 1974, p. 39-41. 5 refs. In Russian. (IAA)

9540 GIANT COERCIVE FORCE AND CERTAIN FEATURES IN THE MAGNETIZATION REVERSAL OF BULKY SINGLE CRYSTALS OF THE INTERMETALLIC COMPOUNDS $Sm(Co_{1-x}Ni_x)_5$. Ermolenko, A.S.; Korolev, A.V. (Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences). JETP Lett. 21: No. 1, 15-16 (5 Jan 1975).

It was observed that in certain ferromagnetic $Sm(Co_{1-x}Ni_x)_5$ compounds the domain walls remain frozen at low temperatures up to very high values of the constant magnetic field. An anomalous anisotropy of the magnetic susceptibility and an anomalously high coercive force, exceeding 83 kOe was observed in bulky single crystals at 4.2 °K. (auth)

9541 STRUKTURA SPLAVOV TSIRKONIYA. (Zirconium Alloy Structure). Ivanov, O. S.; Adamova, A. S.; Tarataeva, E. M.; Tregubov, E. A. Moscow; Izdatel'stvo Nauka (1973). 198p. (In Russian).

Studies published up to 1970 are generalized in a critical fashion. A look is taken at the structure of zirconium alloys in equilibrium and nonequilibrium states. The first part of the book analyzes the structure in the equilibrium state from phase diagrams of binary and ternary systems having zirconium as a base. The second part shows the general regularities in the formation of unstable phases in zirconium alloys, and also the structure of alloys in the nonequilibrium state in concrete phase diagrams of binary and ternary systems. A list of the systems under consideration is presented. (SJR)

9542 INFLUENCE OF CHROMIUM ON THE PASSIVITY OF Zr–Cr ALLOYS. Patil, G. C.; Elayaperumal, K. (Bhabha Atomic Research Centre, Bombay (India). Directorate of Radiation Protection). Trans. Indian Inst. Met.; 27: No. 3, 180-182(Jun 1974).

Zr–1.93% Cr alloy, annealed at 800°C for 1 hour—which is resistant to stress corrosion cracking in boiling methanol +0.4% HCl solution—was found to exhibit an active to passive transition in that solution at a cathodic potential of –0.550V. The effect of increasing the chromium from 0.83% to 1.93% is to increase the stability of the passive film. However, when the Zr–1.93% Cr alloy is annealed at 850°C for 1 hour, the passive film stability is reduced to a large extent resulting in increased dissolution. (auth)

Radiation Effects

9543 (AERE-R-7934) CONSULTANT SYMPOSIUM ON THE PHYSICS OF IRRADIATION PRODUCED VOIDS HELD AT HARWELL, 9th–11th SEPTEMBER 1974. Nelson, R. S. (ed.). (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1975. 355p. (CONF-740956–; HL–75/279(C15)). Dep. NTIS (US Sales Only) $20.75. UK pounds 6.00.

Thirty-eight papers were presented at the conference. All were in NSA scope and separate abstracts are included for 35 of them. Three papers were previously announced in NSA. (SFL)

For abstracts of individual papers see: 9396, and 9544–9577.

9544 (AERE-R-7934, pp 1-17) VOID SWELLING PROBLEM IN SODIUM COOLED FAST REACTORS. Harries, D. R. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The technological implications of void swelling in the design and performance of sodium cooled fast reactors are briefly reviewed; particular emphasis is placed on the behavior of the subassembly wrappers in the unrestrained and restrained core concepts. The present status of the theoretical work and the various experimental approaches adopted in studying the void swelling problem in non-fissile core component materials are surveyed and consideration given to the aspects requiring further research and development. (auth)

9545 (AERE-R-7934, pp 37-38) APPROXIMATE CALCULATION OF ENERGY DEPOSITION IN ION BOMBARDMENT. Manning, I.; Mueller, G. P. (US Naval Research Lab., Washington, DC). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

When using ion bombardment to simulate neutron-irradiation damage, the profile of energy deposition as a function of distance is thought to be of fundamental importance for computing equivalent dosages. The NRL computer code E-DEP-1 calculates this profile. In the first part of this talk this code is partially calibrated by comparing its results with computer simulations of Beeler (in Proceedings of the International Conference on Applications of Ion Beams to Metals, Albuquerque, October 1973) and transport-theory calculations of Brice [Radiation Effects; 11:51 (1971)] of Sigmund, Mathies, and Phillips [Radiation Effects; 11:39 (1971)] and of Winterbon (Radiation Effects; 13: 215 (1972)). The principal source of error in E-DEP-1 is seen to be the neglect of transport effects due to the finite range of the PKA's produced. This error will be small whenever it can be assumed that the PKA range is small compared to the range of the ion beam; the range of validity of this assumption is discussed. Another assumption employed by E-DEP-1 is a statistical one [Kulcinski et al., Radiation Effects; 1:195 (1971)] which accounts for the simplicity of the code; this latter assumption does not seem to introduce substantial errors. E-DEP-1 is restricted to the low-velocity region where the stopping power is proportional to velocity. In the second part of this talk the lifting of this restriction is discussed so that the code, together with its range and range-straggling subroutines, is applicable to high-velocity projectiles such as protons, alpha particles, and light ions of high energy. (Abstract only: paper presented orally at Symposium). (auth)

9546 (AERE-R-7934, pp 39-43) PRIMARY RECOIL SPECTRUM IN THE SIMULATION OF FAST REACTOR RADIATION DAMAGE BY CHARGED-PARTICLE BOMBARDMENT. Marwick, A. D. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The energy spectrum of primary knock on atoms (PKA) in iron subject to a typical fast reactor neutron spectrum is calculated and compared with the PKA spectrum calculated in nickel under bombardment by 46.5 MeV nickel ions (as on the Harwell VEC), 5 MeV nickel ions, 22 MeV carbon ions, 5 MeV protons and 1 MeV electrons. The damage produced by each PKA spectrum is calculated and the proportion of the damage produced by high energy recoils estimated. Results of comparison of the PKA spectra indicate that the nickel ion bombardments are the closest simulation of fast reactor damage. (auth)

9547 (AERE-R-7934, pp 44-49) EFFECT OF CASCADE ANNEALING ON DAMAGE PRODUCTION RATES IN IRRADIATED MATERIALS. Norgett, M. J. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Norgett, Robinson and Torrens (AERE Report TP 494) proposed a damage model, based on computer cascade simulation, for determining the rate of production of Frenkel pairs in irradiated metals. Their derivation neglected any effect of recombination within the cascade due to the thermal migration of defects. Previous annealing studies suggest such recombination may reduce the effective production rate below the value predicted by the NRT model. But the annealing studies start from cascade simulations in which the focused replacement sequences are ignored or deliberately suppressed. If this artificial constraint is relaxed, the interstitials and vacancies separate to greater distances. It is found after annealing these more realistic cascade configurations that the annealing is greatly reduced and corresponds only to an insignificant correction to the accepted damage model. (auth)

9548 (AERE-R-7934, pp 71-77) VOID SWELLING IN FUEL PIN CLADDING. Bramman, J.; Brown, C.; Cawthorne, C.; Fulton, I. (EJ); Linekar, G. (United Kingdom Atomic Energy Agency, Thurso, Scotland). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Immersion density measurements and electron microscopy examinations on a large number of fuel-pin cladding samples have been used to give quantitative data on volume changes, void concentrations, void size distributions, and dislocation densities and on the inhomogeneity of swelling. Inhomogeneity has been found to be very marked in cold-worked material. Though it has been found that void swelling in the cladding is the major determinant of dimensional changes in fuel pins irradiated in DFR, it is now clear that swelling in any sample cannot be simply related to characterizing values of the various parameters quantified by electron microscopy studies. (auth)

9549 (AERE-R-7934, pp 78-82) RATE OF VOID ANNEALING IN M316L STAINLESS STEEL. Cawthorne, C. (United Kingdom Atomic Energy Agency, Thurso, Scotland). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The value of the product of surface energy (gamma) and self diffusion coefficient (D) for neutron irradiated M316L stainless steel has been estimated from the changes in void population during thermal annealing. Void populations were expressed as graphs of void size distribution function v void radius and the changes during annealing were calculated numerically using the Wagner theory of Ostwald ripening. Comparison of the calculated and observed changes in void population indicated that the value of (gamma D) is smaller than expected. (auth)

9550 (AERE-R-7934, pp 83-89) VOIDS AND ROD-SHAPED FEATURES IN 316 STAINLESS STEEL IRRADIATED TO LOW NEUTRON DOSES IN DFR. Brown, C. (United Kingdom Atomic Energy Agency, Thurso, Scotland). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Any choice of reactor material must take account of the factors which influence void nucleation and growth and to elucidate some of these factors a study of specimens irradiated at very low doses is currently being carried out. This report describes the effect of low dose neutron irradiation on three unstressed samples of 316 type stainless steel in the solution-treated condition. After irradiation to 1×10^{22} n/cm^2 at 600°C, solution treated M316 and M316L type stainless steels contain a number of small voids and show low void swelling. Many of the voids in both materials are associated with rod-shaped features lying in the ⟨100⟩ directions and along which preferential void growth takes place giving rise to cylindrical shaped voids. A single crystal electron diffraction pattern has been obtained from one of the rod-shaped features but this is inconsistent with any of the phases usually found in austenitic steels. Post-irradiation isochronal anneals were carried out on the M316 material and the rods were stable up to 700°C but dissolved during 1 hour isochronal anneal at 750°C. Irradiation of solution treated M316 type stainless steel to approximately 1×10^{22} n/cm^2 at 500°C produces a greater concentration of smaller voids than that found in the same material irradiated at 600°C. Few rod-shaped precipitates were visible at this temperature. (auth)

9551 (AERE-R-7934, pp 90-94) VOIDS IN HIGH PURITY Ni IRRADIATED IN DFR. Brown, C. (United Kingdom Atomic Energy Agency, Thurso, Scotland). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

A transmission electron microscope examination of three high purity samples of nickel irradiated in DFR at temperatures around 600°C to a neutron dose of approximately 1×10^{22} neutrons/cm^2 was carried out and comparisons made with VEC work and other reactor data. In these samples the voids have a truncated octahedral shape and have diameters ranging from 150 to 2000 Å. Some of the voids apparently touched and coalesced to form clusters of very large voids with diameters greater than 2000 Å. Grain boundary denudation and enhanced swelling at the edge of the denuded zone took place. The presence of voids on the grain boundaries and some larger voids within the denuded zones indicates that grain boundary migration occurred. (auth)

9552 (AERE-R-7934, pp 101-118) VOID SWELLING PRODUCED BY 5 MeV Ni IONS. Johnston, W. G. (General Electric Corp. Research and Development, Schenectady, NY); Rosolowski, J. H.; Turkalo, A. M.; Lauritzen, T. Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The void swelling of Types 304 and 316 steels is reviewed, and results are presented for Type 321, Type 318 and 12R72HV. In the solution-treated condition, these austenitic stainless steels swell large amounts (30% to 60%) at a damage level of 140 dpa at 625°C. A survey of 17 commercial alloys revealed that several, including PE-16 first reported by Hudson, Mazey and Nelson [J. Nucl. Mater. 41, 257 (1971)], swell less than Type 316. The major composition of a commercial alloy seems to be the most important factor in determining its swelling behavior, and the dominant role of major composition has been substantiated with a series of special alloys with only Fe, Cr, and Ni. The depth distribution of swelling produced by 5 MeV ions gives no indication that the proximity of the surface affects swelling in the peak damage region. The surface structures formed during ion bombardment are described. Although these very interesting structures merit additional study, there is no evidence that the phenomena involved seriously affect the swelling investigations. (auth)

9553 (AERE-R-7934, pp 119-125) SOME OBSERVATIONS OF VOID SWELLING PRODUCED DURING 20 MeV C^{2+} AND 46.5 MeV Ni^{6+} ION IRRADIATION. Nelson, R. S.; Hudson, J. A.; Mazey, D. J. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

New data on the dose and temperature dependencies of void swelling in nickel and 316 and 321 steels bombarded with 46.5 MeV Ni^{6+} ions are presented. This is compared with previous data using 20 MeV C^{++} ions. While the results for nickel are very similar in both cases, the new results for steel show significant differences. In general the Ni^{6+} ion swelling values are much less than those for C^{2+} ion irradiation, and appear to be shifted to higher damage values by about a factor of two. These results can be interpreted in terms of the differences in primary recoil spectrum produced by the two irradiations and highlight the importance of providing the best possible simulation if an attempt is to be made to reproduce the neutron situation in a meaningful way. In addition experimental observations relating to the nucleation of voids during ion bombardment are discussed. (auth)

9554 (AERE-R-7934, pp 126) SIMULATION EXPERIMENTS WITH THE HVEM. Laidler, J. J.; Garner, F. A. (Hanford Engineering Development Lab., Richland, WA). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The development of HVEM electron irradiation methods for simulation of neutron-induced void formation in metals has added a new dimension to the study of this phenomenon. The technique provides the experimenter with the capability for continuous, direct observation of the developing microstructure during irradiation. HVEM irradiation experiments must be conducted, however, under very carefully controlled conditions in order that the full potential of the technique can be realized. Close attention must be paid to spurious effects which can arise due to surface interactions, beam heating, and spatial variations in the electron flux. It is also essential to account for variations in microstructure throughout a specimen, since the small irradiated volume may not be statistically representative of the bulk structure. Means for dealing with these effects are discussed in detail. Results are shown which indicate a very strong compositional dependence of void nucleation and a relative insensitivity of void growth to composition variations in stainless steel. It has also been found that previous conceptions of the role of dislocations in the void formation process are not fully accurate representations of the behavior found by direct observation. (auth)

9555 (AERE-R-7934, pp 127) INVESTIGATION OF $^{12}C^+$ AND $^{58}Ni^+$ ION INDUCED VOID FORMATION IN PURE Ni. Ryan, T. D. (Univ. of Michigan, Ann Arbor). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

A detailed investigation of the void and dislocation microstructure of pure nickel samples irradiated with either 4 MeV $^{58}Ni^+$ or 1 MeV $^{12}C^+$ ions has been carried out in the temperature range 450 to 675°C for doses up to 60 dpa. The effects of projectile mass on void formation under conditions of similar ion penetration and calculated peak displacement rate are compared. All irradiations were carried out in an ultra-high vacuum system at a pressure of less than 10^{-7} torr. The dose dependence of swelling to 60 dpa and the temperature dependence for self-ion irradiations are in substantial agreement with previous observations. At 8 dpa, the peak swelling was observed in a 600°C irradiation in which the void number density was 2×10^{15} cm^{-3} and the void volume fraction was 2.4%. In the $^{12}C^+$-ion irradiations a linear dependence of void volume fraction on dose was again observed above 5 dpa but the magnitude was greater than that for the $^{58}Ni^+$-ion irradiation at equivalent doses as calculated from the Brice code. The peak swelling temperature for $^{12}C^+$-ion irradiation is lower than for self-ion irradiations and the peak width is greater. It is

believed that this data is consistent with a higher free defect cross section for $^{12}C^{+}$ ions as opposed to $^{58}Ni^{+}$ ions resulting from differences of in-spike point defect recombination. (auth)

9556 (AERE-R-7934, pp 128-133) SWELLING OF STAINLESS STEEL 304 IN HVEM EXPERIMENTS. Buswell, J. T. (Central Electricity Governing Board, Berkeley, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Solution treated 304 was irradiated with 1 MeV electrons, in a High Voltage Electron Microscope, at temperatures in the range 490 to 610°C. Clear evidence was obtained of a double peak in the temperature dependence of swelling at 20 dpa. The maximum swelling values occurred at 520 and 585°C, respectively. Swelling in the lower temperature peak was controlled by the void number density but swelling in the higher temperature peak was dependent upon the mean void size. The possibility exists that the presence and magnitude of the higher temperature peak was influenced by the stress conditions within the electron irradiated areas. There was no evidence of a saturation in swelling in specimens irradiated to 70 to 100 dpa at 510 or 560°C. (auth)

9557 (AERE-R-7934, pp 134-139) POISONING OF DISLOCATIONS BY IMPURITY ATMOSPHERES AS A MECHANISM FOR CONTROL OF VOID SWELLING DURING IRRADIATION. Norris, D. I. R. (Central Electricity Governing Board, Berkeley, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

A mechanism is suggested to account for the effect of impurity content upon void swelling in metals and commercial alloys. Atmospheres of either over-sized substitutional solutes or interstitial solutes modify the stress field of a dislocation so as to reduce the drift flow of interstitials. This means a reduction in the dislocation preference which is the driving force for void nucleation and growth. A simple expression is derived for the critical atmosphere strength that would eliminate the preference. The effect is strong in systems where the impurity atoms remain in solution during irradiation, but are surrounded by large strains in the matrix. Atmospheres are sufficiently mobile during irradiation to stay with dislocations as they climb, provided that precipitation does not occur. The balance between several competing processes determines the actual atmosphere strength, which may in practice approach the critical value. In the special case when climb sweeping and irradiation recoils dominate, the relationship between impurity concentration and swelling rate is determined. (auth)

9558 (AERE-R-7934, pp 140-146) VOID FORMATION IN A BINARY Ni ALLOY. Hudson, J. A.; Ashby, S. J. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Earlier work on void formation in several binary nickel alloys bombarded at 525°C has been extended to include the dose dependence of swelling in Ni 27.5% Cr at various temperature. Specimens of the alloy were doped with 10 ppM He and bombarded with 46.5 MeV Ni^{6+} ions to doses up to 60 displacements per atom at temperatures in the range 500 to 700°C. The swelling and dislocation structure in the irradiated specimens were measured by transmission electron microscopy and the results compared with previous data on pure nickel and commercial austenitic stainless steels. The alloy showed very low swelling at 525 and 540°C, characteristic of interstitial trapping but at higher temperatures the swelling rate increased until at 700°C ~20% swelling occurred after 60 dpa. (auth)

9559 (AERE-R-7934, pp 147-157) GENERALIZED THEORY OF NUCLEATION. Wiedersich, H. (Argonne National Lab., IL). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

A general and conceptually simple method of calculation of nucleation rates is developed. The method is based on the steady-state solution of a set of reaction-rate equations that describe the formation, growth, and decay of embryos by reactions with mobile species. The method can be applied to ordinary nucleation in single and multicomponent systems as well as to the nucleation of defect clusters occurring during irradiation. The inclusion of the competing effects of excess interstitials and excess vacancies, effect of gases, and reactions with divacancies and other mobile defect clusters on the nucleation of defect aggregates does not present the additional, principal difficulties that are encountered when adapting conventional nucleation theory to the nucleation of defect aggregates during irradiation. (auth)

9560 (AERE-R-7934, pp 158-179) EFFECT OF GAS ON VOID NUCLEATION. Russell, K. C. (Massachusetts Inst. of Tech., Cambridge). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Gas atoms, particularly helium, were observed to exert a strong influence on void nucleation. At one time it was believed that dissolved helium was a necessary condition for void formation–a view which has since been abandoned. Helium may assist the nucleation process by entering the void, and exerting a stabilizing pressure. This effect may be quite large if the gas atoms are reasonably mobile, and arrive at the void at a rate comparable to the vacancy. Substitutional helium is expected to have limited mobility; however, it was recently proposed that interstitial solvent and substitutional helium could react to give a rapidly moving helium interstitial, which could in turn aid void nucleation. Non-inert dissolved gases, such as hydrogen may stabilize voids by adsorbing at the void: matrix interface and lowering the surface energy. The void nucleation rate is very sensitive to the surface energy, so that a surface active solute could give a large rate increase. Dissolved hydrogen and oxygen may react to form water vapor with large intravoid pressures, and a significant stabilizing effect. (auth)

9561 (AERE-R-7934, pp 180) VOID NUCLEATION AS INFERRED FROM REACTOR DATA. Bloom, E. E.; Farrell, K.; Stiegler, J. O.; Yoo, M. H. (Oak Ridge National Lab., TN). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Void nucleation in neutron irradiated materials can only be inferred, not directly observed. There are pitfalls and limitations on the information to be derived in this way. Since few experiments have been made that involve a change in only one parameter, interpretation of the observations is not always clear. A common sequence of events in the development of neutron damage structure has been found for all materials and irradiation conditions. An exposure period of variable length, termed the induction or incubation fluence, precedes the formation of a visible damage structure. Dislocation loops or a dislocation structure then appear followed at a significantly later stage by the formation of voids. The dislocation structure and void nucleation are intimately related, but there is not such a strict correlation with dislocations and void growth; factors that inhibit the nucleation of loops also inhibit the nucleation of voids. The effects of irradiation temperature and fluence on the incubation fluence and on the void concentration will be discussed for annealed high purity metals and solid solution alloys. The effects of amount and distribution of pre-injected gases and of alloy composition on the dislocation and void populations will also be considered. It is shown that existing void nucleation models that treat the dislocation structure as an adjustable parameter are necessarily incomplete because the initial phases of void formation, probably nucleation, are tied to the development of a dislocation structure that is peculiar to material and irradiation conditions. The greatest need in understanding this problem is for experimental information on the factors controlling or limiting the nucleation of loops. (auth)

9562 (AERE-R-7934, pp 181-187) INFLUENCE OF NEUTRON IRRADIATION TEMPERATURE ON THE VOID CHARACTERISTICS OF BCC METALS AND ALLOYS. Moteff, J.; Sikka, V. K.; Jang, H. (Univ. of Cincinnati, OH). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Some of the void characteristics of the bcc metals, Mo, Mo–

0.5 Ti, Nb, Nb–1 Zr, W, and W–25 Re, irradiated in the Row 7 midplane of the EBR-II facility to a fast neutron fluence of about 1×10^{22}n cm^{-2}, En > 1 MeV, are presented. These specimens were simultaneously irradiated at six temperatures (430, 580, 700, 800, 900, and 1050°C) which happen to lie in the range where the observable void density and size parameters show two distinct types of behavior. These parameters are essentially constant at the lower three temperatures. Above the 700°C temperature the void density decreases and the size increases with increasing irradiation temperatures. The resulting volume swelling shows that two peaks exist suggesting that two different mechanisms may be responsible for the observed swelling. Alloying appears to affect the swelling behavior of the three base metals Nb, Mo, and W in radically different ways. The solid solution W–25 Re alloy, for instance, did not exhibit any swelling at all, however, a profuse quantity of rhenium rich second phase did occur at all six temperatures. The lattice spacing for the cases where a superlattice of voids have been observed to occur is strongly dependent on the irradiation temperature, a fact that is not now treated in any of the existing theories on the ordered void structure. The lattice parameter varies from about 220 Å at 430°C up to about 660 Å at 1050°C. The apparent uniformity in the increase of the lattice parameter with an increase in irradiation temperature suggests that this behavior could be used to monitor the temperature of uninstrumented reactor irradiation capsules. (auth)

9563 (AERE-R-7934, pp 188-196) NUCLEATION AND GROWTH OF INTERSTITIAL DISLOCATION LOOPS. Hayns, M. R.; Perrin, R. C. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The theory of void swelling developed by Brailsford and Bullough [J. Nuc. Mat. 44:121 (1972)] requires as input parameters the steady state concentration and size of embryonic interstitial dislocation loops. It has been found that the theory is sensitive to these quantities and consequently reliable values are needed. The steady state concentrations have, in some cases, been obtained experimentally, but no systematic series of measurements is available which covers the range of conditions of interest. Furthermore, there can be no experimental data on the nucleation stages due to the small size of the objects involved. A theoretical study of the nucleation and subsequent growth of interstitial loops is described which gives both a further understanding of the basic mechanisms of loop nucleation and a prediction of loop concentrations and size distributions for use in the steady state rate theory of void swelling. The approach is to apply the well known methods of chemical rate theory to a hierarchy of linear simultaneous differential equations. In this way, the time evolution of the loop size distribution may be investigated and such concepts as nucleation time exposed. With the problem set out in this way many processes may be conveniently introduced into the model. Thus such features can be included as vacancy mobility, thermal dissociation of loops, the mobility of di-interstitial loop proto-nuclei, the effect of grain boundaries and the properties of the denuded layer systematically and study the effect of these mechanisms on the whole system. Further, the results may be compared in a transparent way with other theoretical models. (auth)

9564 (AERE-R-7934, pp 197-204) SIMULTANEOUS BOMBARDMENT OF Mo WITH Ni AND He IONS. Brimhall, J. L. (Battelle Pacific Northwest Labs., Richland, WA). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Molybdenum single crystals were bombarded simultaneously with 5 MeV Ni^{2+} ions and 200 keV He^{+} ions at 900°C. The dose rates were adjusted so as to produce 2 ppM He per 1 dpa produced by the nickel ions. Specimens in which the helium was pre-injected and in which no helium was present have also been bombarded with the Ni^{2+} ions. There was no measurable difference in the void microstructure between specimens in which there was no helium and in which helium was injected simultaneously. In the case of helium pre-injection, the voids were measurably smaller than in the other bombardment conditions. It can be shown that the very high void nucleation rate in ion bombarded molybdenum can mask the effect of helium under certain dose rate and temperature conditions. (auth)

9565 (AERE-R-7934, pp 205-211) INFLUENCE OF VACANCY FLUX SUPERSATURATION AND GAS CONCENTRATION ON VOID NUCLEATION. Singh, B. N. (Danish Atomic Energy Commission, Roskilde, Denmark); Foreman, A. J. E. Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Since both the vacancy flux supersaturation and the concentration of gas atoms are vital entities in determining the nucleation of voids during irradiation, their influence on the nucleation of voids was studied experimentally and theoretically. Their effect on the critical embryo size for void nucleation was demonstrated and a new theory for void nucleation in terms of the Brownian motion of vacancy-gas atom complexes has been proposed. The effects of vacancy supersaturation (in terms of damage rate and cold work) and gas concentration on void number density predicted by the proposed theory are found to be consistent with experimental observations. (auth)

9566 (AERE-R-7934, pp 212-230) IMPURITY TRAPPING AND ITS EFFECT ON VOID GROWTH. Schilling, W.; Schroeder, K. (Kernforschungsanlage, Juelich, Ger.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The possible mechanism by which interstitial and/or vacancy trapping could influence the void growth are reviewed. First, a phenomenological picture of the delay of defect diffusion by trapping and subsequent release after some delay time is developed. This leads to the definition of an effective diffusion constant of defects to sinks in the rate equations for void growth. Secondly, the trapping radius and trapping time, the two parameters used in the model to describe the delayed diffusion, are discussed in relation with the defect-trap interaction potential. In the third part experimental methods which yield information on the trapping of radiation induced interstitials and vacancies are outlined. As examples the strong trapping of self interstitials at substitutional impurities in Al and the trapping of vacancies by C and N-interstitials in Fe are discussed in more detail. (auth)

9567 (AERE-R–7934, pp 231-238) IRRADIATION-INDUCED SOLUTE SEGREGATION. Okamoto, P. R.; Wiedersich, H. (Argonne National Lab., IL). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Radiation-induced segregation of alloying elements to voids and external surfaces during bombardment with energetic particles has been observed in an 18/8 austenitic steel containing 1 wt % silicon. Auger electron spectroscopic analysis of nickel ion-bombarded surfaces indicates that undersized (Ni, Si) and oversized (Cr) solute atoms segregate toward and away from the surface, respectively. The correlation suggests that undersized substitutional elements are more readily accommodated as interstitials than oversized alloying elements and that solute transport by interstitials may dominate segregation to defect sinks. An analysis of the sign and magnitude of the size dependence of the misfit strain around voids produced during low-dose electron irradiation suggests that the same segregation phenomenon occurs at void surfaces. Further evidence of segregation is provided by the subsequent nucleation and growth of a second phase around the voids. These results indicate that radiation-induced segregation effects are of considerable importance to a detailed understanding of a radiation-induced swelling and to radiation-induced surface phenomena such as blistering and sputtering. (auth)

9568 (AERE-R–7934, pp 239-256) GENERATION OF CLUSTER DAMAGE DURING IRRADIATION OF METALS. Eyre, B. L.; English, C. A. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th–11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The experimental information that has contributed to the understanding of cluster damage structures in bcc and fcc metals irradiated at low temperatures is examined. Three factors are identified as having a major influence on the survival of point defects to form clusters and on the nature and distribution of these

clusters. These are:- (a) the interaction of point defects with dislocations, (b) the damage processes occurring during irradiation and (c) impurity content in the irradiated metal. Discussion is extended to consider the effect of increasing irradiation temperature providing a lead into a more general consideration of the formation and growth of voids in terms of the influence exerted by the three factors. (auth)

9569 (AERE-R-7934, pp 257-267) OBSERVATIONS OF DISLOCATION STRUCTURE AND CAVITIES FORMED BY ANNEALING IN TYPE 316 STEEL AFTER ION IRRADIATION AT AMBIENT TEMPERATURE. Mazey, D. J.; Francis, S. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th-11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Establishment).

Defect structures generated in type 316 austentic stainless steel during annealing following irradiation in the Harwell Variable Energy Cyclotron with 40 MeV He^+ or 46.5 MeV Ni^{6+} have been studied by transmission electron microscopy. After implantation with 1 appM He, no defect clusters were seen between 25 and 750°C but helium bubbles formed at higher temperatures. Annealing after a 10 appM He implant produced a few faulted loops at ~650°C and helium bubbles at temperatures between 600 and 1100°C. In steel containing 100 and 1000 appM He, clusters and small loops formed between 25 and 570°C. Growth to form $\sim 5 \times 10^{14}$ cm^{-3} faulted interstitial loops occurred between 570 and 750°C, and helium bubbles formed and grew at temperatures $\gtrsim$ 600°C. The interstitial atom fraction initially contained in loops at 650°C, after the 100 appM He implant was $\sim 10^{-4}$. Loops adjacent to grain boundaries and non-coherent twin boundaries shrank during annealing to form a denuded zone whose width increased at $(t)^{\frac{1}{2}}$ at temperatures between 570 and 750°C. Analysis of the growth-rates of the denuded zone gave an activation energy of 2.6 eV. In 316 steel not containing helium and irradiated with 46.4 MeV Ni^{6+} to 10 dpa, prismatic loops formed and grew in the range 25 to 750°C. After Ni^{6+} irradiation to 1 dpa small clusters and loops were formed, but after a 1 hour anneal at 650°C these disappeared and small voids ($3 \times 10^{14} cm^{-3}$, radius 35Å) evolved. (auth)

9570 (AERE-R-7934, pp 263-267) DETERMINATION OF VOID FORMATION PARAMETERS IN METALS BY HEAVY-ION IRRADIATION. Sprague, J. A.; Westmoreland, J. E.; Smidt, F. A. Jr.; Malmberg, P. R. (Naval Research Lab., Washington, DC). Jan 1975.

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th-11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Although the void and dislocation structures produced by neutron and charged-particle irradiations of metals are qualitatively similar, the quantitative details of the structures are controlled by a large number of factors, many of which are not yet fully understood. This makes it extremely difficult at the present time to make a direct simulation of a specific neutron irradiation by any one charged-particle bombardment. The simulation problem is approached less directly by using detailed microstructural data on nickel-ion bombarded nickel to compare with the predictions of theoretical models for void nucleation and growth. An attempt is made to use these comparisons to determine appropriate values for undetermined parameters that appear in the models. Since most of the work to date has involved considerations of void growth, this part of the problem is stressed. (auth)

9571 (AERE-R-7934, pp 274) VOID SWELLING OF Nb AND Nb-1 AT.% Zr ON $^{58}Ni^+$ IRRADIATION. Loomis, B. A.; Taylor, A.; Gerber, S. B. (Argonne National Lab., IL). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th-11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The temperature dependence for void swelling in high-purity Nb and Nb-1 at.% Zr alloy on $^{58}Ni^+$ irradiation to 50 dpa has been determined. The void swelling curve for pure Nb and for the Nb-1 at.% Zr alloy shows two peaks centered at ~825 and ~1000°C. The portion of the swelling curve centered about 825°C may be attributed to the usual void nucleation and growth processes. However, the portion of the swelling curve centered about 1000°C is thought to be due to a combination of void coalescence and oxygen or nitrogen pickup during irradiation. The effect of the Zr and Nb was to increase the void swelling throughout the temperature range for void formation. In addition to a determination of the parameters necessary for a calculation of the void swelling of these metals, the average loop diameter, loop number density, and length of dislocation in the irradiation specimens have been determined. The effect on the void swelling of Nb and Nb-1 at.% Zr on doping with oxygen has also been determined. The general observation was that oxygen impurity resulted in an increased void number density and a corresponding decrease in the average void diameter. Furthermore, it as observed that void ordering occurred only in the oxygen d ped metals and in a very limited temperature range at 50 dpa. (auth)

9572 (AERE-R-7934, pp 275-286) RECENT ADVANCES IN THE RATE THEORY OF VOID SWELLING, CASCADE EFFECTS. Bullough, R. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th-11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

To correlate successfully the HVM, VEC, and Reactor swelling results in a single material it is necessary to include the formation of vacancy loops when the irradiation produces cascade damage. Such an extension of the homogeneous rate theory has recently been achieved by Bullough, Eyre and Krishan — this theory is reviewed. Particular attention is given to the sensitivity of the high temperature reactor swelling to the transmutation gas generation rate. (auth)

9573 (AERE-R-7934, pp 287-298) VOID SWELLING IN AUSTENITIC STEELS AND Ni BASE ALLOYS: EFFECTS OF ALLOY CONSTITUTION AND STRUCTURE. Harries, D. R. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th-11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

An evaluation of the constitution and structure of iron-chromium-nickel alloys suggests that the relatively high and variable void swelling of austenitic steels (containing 18 ± 3wt % Cr, $\lesssim$ 18wt % Ni), irradiated in the Variable Energy Cyclotron with Ni^{6+} ions to a dose of 40 dpa at 600 to 625°C, is due to the formation of sigma (σ) phase. The observed low void swelling in alloys with higher nickel contents ($\gg$ 18wt %) is associated with their single (γ) phase structures and possibly to an increased stacking fault energy and/or the formation of short-range order. The available experimental data, together with considerations of the effects of alloying and impurity elements on the constitution and structures, indicate that, for sodium cooled fast reactor applications, the optimum void swelling resistance may be obtained with a single (γ) phase alloy with a base composition of Fe + $\lesssim$ 20wt % Cr + 35 to 40wt % Ni. (auth)

9574 (AERE-R-7934, pp 299-312) EFFECT OF VOID DENSITY AND CARBON CONCENTRATION ON THE SWELLING OF TYPE 316 AUSTENITIC STEEL IRRADIATED IN THE HVM. Makin, M. J.; Walters, G. P. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th-11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

Extensive studies of the void characteristics produced by 1 MV electron irradiation have been made on solution treated Type 316 austenitic steel in the temperature range 500 to 600°C. It was found that the swelling depends sensitively on two factors, the void density and the carbon concentration. Care is required to clearly separate these two effects. As the void density is increased the swelling at constant dose, temperature and carbon content, initially increases linearly up to a maximum value and then decreases. This behavior, which was found at all temperatures, is attributed to (a) a "growth zone" surrounding each void which is limited in radius by either the dislocation density (when the void density is low) or by the intervoid spacing, and (b) an inner "dead zone" close to the void which does not contribute to void growth. The diffusion theory of void growth does not appear to adequately describe the results. The effect of carbon was investigated over the range < 0.2 to 1.0 wt%, and three effects were identified. First, carbon reduced the rate of void growth at 500°C, second, carbon in solution increased the void density at all temperatures, and third, large carbide precipitates locally suppressed void formation at 500°C. (auth)

9575 (AERE-R-7934, pp 313-318) EFFECT OF HIGH VOID DENSITIES ON THE RATE OF VOID SWELLING. Foreman, A. J. E.; Makin, M. J. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th-11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The void swelling observed in 316 and 321 stainless steel irradiated in the HVEM varies markedly with the void density. The swelling falls off very rapidly with increasing void density, which is contrary to the predictions of simple rate kinetic theory models. Several possible explanations for this marked discrepancy between theory and experiment are discussed in terms of the cellular model for void growth, including the possibility that pipe diffusion of point defects may be occurring along dislocations. This would produce a "dead zone" close to the surface of each void and the consequences of such a zone are calculated. (auth)

9576 (AERE-R-7934, pp 319-329) VOID LATTICE AND OTHER REGULAR ARRAYS OF DEFECTS. Stoneham, A. M. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th-11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The void lattice was one of the most surprising results of heavy radiation damage in metals. Experimental results are given together with the present theoretical views on the reasons for the stability of the lattice and the way in which it forms. Since many other defect systems form regular arrays on a comparable scale, some of these are compared and contrasted with the void lattice. (auth)

9577 (AERE-R-7934, pp 330-350) VOID NUCLEATION AS INFERRED FROM NEUTRON IRRADIATIONS. Bloom, E. E.; Yoo, M. H.; Farrell, K.; Stiegler, J. O. (Oak Ridge National Lab., TN). Jan 1975.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

In consultant symposium on the physics of irradiation produced voids held at Harwell, 9th-11th September 1974. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment).

The role of void nucleation in neutron-induced swelling is considered, and several general summary statements are offered regarding heterogeneity of nucleation sites, intimate connection between the sites and attendant dislocation microstructures, and specific effects of neutron flux, insoluble gases, solute impurities, alloying elements, precipitates, cold work, and grain size. Some definitive experiments and analyses are suggested to further the understanding of void nucleation. (auth)

9578 CEA-CONF-2921) CONTRIBUTION TO THE STUDY OF TEXTURE EFFECTS ON THE IN-PILE DEFORMATION RATE OF ZIRCONIUM ALLOYS. Thomas de Montpreville, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1974. 5p. (In French). INIS.

From European conference on irradiation behaviour of fuel cladding and core component materials; Karlsruhe, F. R. Germany (3 Dec 1974).

Samples consisting of combinations of three types of grains were examined. Creep and then growth of these samples were studied. An attempt was made to apply this study to thin tubes subjected to monoaxial and biaxial stresses. (FR)

9579 (CEA-CONF-2922) Ni-Fe AND Ni-Si ALLOYS SHOWING AN ABSENCE OF SWELLING UNDER FAST NEUTRON IRRADIATION. Silvestre, G.; Silvent, A.; Regnard, C.; Saintford, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). 1974. 4p. (In French). INIS.

From European conference on irradiation behaviour of fuel cladding and core component materials; Karlsruhe, F. R. Germany (3 Dec 1974).

Ni-Fe and Ni-Si alloys were studied, the choice of iron being due to the wide range of Ni-Fe solid solutions, that of silicon to its presence in steels and the possibility of its interaction with point defects. Postirradiation observations show no appreciable effect of iron, whereas swelling is strongly affected by the presence of Si. For 50-50 Ni-Fe and 92-8 Ni-Si alloys, irradiation favors the precipitation of Ni_3Fe and Ni_3Si. The absence of swelling could be due to a recombination of free vacancies with interstitials trapped by the stress field of the precipitates. (FR)

9580 (CEA-CONF-2924) SIMULATION OF THE CREATION OF DISPLACEMENT SPIKES BY SEVERAL-BODY INTERACTION. Dang Dinh, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1974. 2p. (In French). INIS.

From European conference on irradiation behaviour of fuel cladding and core component materials; Karlsruhe, F. R. Germany (3 Dec 1974).

The ANGIANG model was developed to take over from the MARLOWE model when the energy of the incident atom is too low for the two-body approximation to apply. (FR)

9581 (CEA-CONF-2929) RADIATION-INDUCED CREEP: DEVICE AND FIRST RESULTS. Cartier, L.; Dupouy, J. M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1974. 4p. (In French). INIS.

From European conference on irradiation behaviour of fuel cladding and core component materials; Karlsruhe, F. R. Germany (3 Dec 1974).

A device was developed for continuous creep measurement in the central channel of Rapsodie. A first creep test was carried out at 650 deg C. It is shown that the choices were valid and some slight imperfections were detected. (FR)

9582 (CEA-CONF-2936) RADIATION EFFECTS ON THE CALIBRATION OF W-Re THERMOCOUPLES. Schley, R.; Bazin, J.; Matteudi, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1974. 10p. (In French). INIS.

From international colloquium on high-temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

The work carried out in this field, especially at the CEA, is reviewed. A recent electron microprobe analysis of an irradiated thermocouple is described and this test is linked to a calculation method allowing the composition of the wires to be determined as a function of the integrated neutron flux. This suggests a possible method to correct the temperature values on irradiated thermocouples from the calibration of tungsten-rhenium-osmium alloys. (FR)

9583 (CEA-R-4633) VOIDS FORMATION IN FAST NEUTRONS IRRADIATED ALUMINIUM. Risbet, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). Apr 1975. 130p. (In French). Dep. NTIS (US Sales Only) $9.50.

Thesis. Submitted to Paris Univ., Orsay, France.

Void formation in fast neutron irradiated aluminium (T = 55°C) was studied as a function of dose rate, fluence, initial cold work, and impurity content. Transmission electron microscopy gave the following results: (1) void nucleation is heterogeneous and (2); voids are formed near dislocations. This effect seems to be due to the local variations of vacancy supersaturation and gas trapping by dislocations. The comparison of the different theories with experiment leads to the conclusion that if the published models predict reasonably well void growth at doses where voids are randomly distributed (high dose), there is a great discrepancy between calculated and measured growth rates in the early stages of irradiation. Experimental observations indicate that this discrepancy is due to the fact that, in the early stages, growth is enhanced by the presence of dislocations in the neighborhood of voids. The dislocation density increase with dose is partly due to the formation of vacancy loops. These loops are not due to vacancies precipitation, but result from a debris mechanism involving dislocation climb. The effect of metallic impurities depend on their type and distribution. Copper, iron and vanadium delay void formation; magnesium and silver have no effect. These results can be explained by a mechanism of interstitial trapping by impurities in the neighborhood of dislocations. (auth)

9584 (JUL-1166) RECOVERY MEASUREMENTS ON LEAD AFTER ELECTRON IRRADIATION AT 4.7°K. Schroeder, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Feb 1975. 75p. (In German). Dep. NTIS (US Sales Only) $6.75.

Thesis. Submitted to Technische Hochschule, Aachen, West Germany.

Using electrical resistivity measurements the recovery of low temperature (4.7°K) irradiated Pb has been investigated. Activation energy measurements were made by change of slope -method. The dose dependent recovery stage in the temperature range 140 to 190°K has been determined based on free migration of single vacancies having migration energy Q_V^m = 0.43 eV (stage III). In the last recovery stage at room temperature (stage V) the vacancy-clusters dissociate with an activation energy Q = 1.05 eV which is equal to the self-diffusion energy of Pb. Stage I (migration of the

self-interstitials) seems to be below irradiation temperature. Using damage rate measurements, the threshold energy to produce Frenkel defects in Pb with electron irradiation has been determined to be 0.7 MeV, which means 12.5 eV maximum transferred energy. (auth)

9585 DECREASE IN THE VOID GROWTH RATE BY INTERSTITIAL TRAPPING. Koehler, J.S. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). J. Appl. Phys. 46: No. 6, 2423-2428 (June 1975).

Void growth during neutron or charged-particle irradiation at temperatures in the range $0.4T_m \leq T \leq 0.6T_m$ is described in pure metals and in metals containing impurities which trap interstitials. It is shown that the equations for the steady state can be integrated analytically. For cases in which strong trapping occurs the recombination rate is enhanced and the rate of void growth is reduced. A discussion of how strong trapping can be achieved is given. (auth)

9586 PROTON-INDUCED ELECTRON EMISSION FROM CHARACTERIZED NIOBIUM SURFACES. Musket, R. G. (Sandia Labs., Livermore, CA). J. Vac. Sci. Technol.; 12: No. 1, 444-447 (1975).

Both the electron emission coefficient (electrons/ion) and the energy distribution of emitted electrons were determined for bombardment of polycrystalline niobium by 30-400 keV protons. In situ characterization of the niobium surfaces was accomplished using electron-induced Auger electron spectroscopy. Emission coefficient measurements were made for protons incident along the surface normal and along the axis at 45^0 from the surface normal. Electron energy distributions were determined using a hemispherical retarding analyzer with the proton beam at 45^0 from the surface normal and at 90^0 from and coplanar with the axis of the analyzer. Results are discussed and interpreted with reference to electron emission theories and previous experiments. (auth)

9587 FRANK'S KINEMATIC THEORY OF CRYSTAL DISSOLUTION APPLIED TO THE PREDICTION OF APEX ANGLES OF CONICAL ION-BOMBARDMENT STRUCTURES. Witcomb, M. J. (Univ. of the Witwatersrand, Johannesburg). J. Mater. Sci.; 10: No. 4, 669-682(Apr 1975).

The construction process associated with the kinematic theorems of crystal dissolution due to Frank has been applied to the problem of determining the characteristics of surface topography caused by ion bombardment. Such an approach is shown to be valid by comparison between experimental results on and dissolution constructions applied to ion-etched spheres. Emphasis has been placed on determining the apex angle of equilibrium cone structures on crystalline materials. The values predicted for the apex angle by Frank's method have been found in good agreement with those measured experimentally and values derived from the peak of sputter yield curves or from ion channeling calculations. Using different starting shapes, the importance is stressed of ensuring the presence of adequate orientation directions without which only nonequilibrium dome type structures or pseudo-cones develop. (auth)

9588 FUNDAMENTAL PROCESSES IN SURFACE EROSION BY SPUTTERING. Kistemaker, J.; Roosendaal, H. E. (Instituut voor Atoom- en Molecuulfysica, Amsterdam). Jap. Appl. Phys.; No. Suppl. 2, 571-578(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

After a general introduction on various processes causing surface faceting, a phenomenon is demonstrated which is caused by surface sputtering (Ne^+ on Cu (100) surface) and which is extremely angular dependent. A variation of one degree in the range of 37° to 41° angle of incidence relative to the normal on the surface can cause dramatic changes in the optical appearance. At 39°, and room temperature, with Ne^+ 10 to 20 keV, there is a milky shine which is due to the Tyndall effect. The facets on the surface are very regular at an interdistance of the wave tops of about 8000 Ångstroms. This appearance is thought to be due to the building up of dislocation arrays due to perpendicular replacement focusing into the bulk of the Cu crystal. This process is maximum at 39° angle of incidence. The beautiful development of $(1\bar{1}0)$ planes during this sputtering process is bound to temperatures lower than 350 K. For higher temperatures the etching becomes more rolling which is also the case in Ar^+ ion bombardment. Ar^+ produces a rolling surface, Ne^+ sharp facets, bombardment. Ar^+ produces a rolling surface, Ne^+ sharp facets, and He^+ blisters. Doses are very high (10^{19} ions cm^{-2}). (auth)

9589 ANTIFRICTION PROPERTIES OF SOME IRRADIATED STEELS IN A SODIUM STREAM. Krasnoshchekov, M. M.; Lysyak, O. D.; Markovskii, E. A. Sov. At. Energy (Engl. Transl.); 37: No. 3, 976-978(Sep 1974).

Translated from At. Energ. (USSR); 37: No. 3, 257-258(Sep 1974).

Hot hardness, friction, and wear tests were performed on Kh18N9, R18, and EI-347Sh steels and also alloys TsN-2 and TsN-12. Untreated samples, annealed samples, and samples irradiated with fast or thermal neutrons were used to determine antifriction characteristics under simultaneous load, sodium stream, and elevated temperature. A direct correlation was found between the change in resistance to wear due to irradiation and the change in hardness of the materials. (auth)

9590 EFFECT OF GAMMA IRRADIATION ON THE DECOMPOSITION KINETICS OF AUSTENITE IN STEEL EI-69. V'yunnik, I. M.; Konozenko, I. D.; Krulikovskaya, M. P. Sov. At. Energy (Engl. Transl.); 37: No. 3, 981-984(Sep 1974).

Translated from At. Energy. (USSR); 37: No. 3, 260-263(Sep 1974).

Hardened samples of EI-69 steel were tempered in successive steps, during which some samples were gamma radiated at 1500 R/sec. Hardness, metallographic and x-ray measurements were made after each stage of tempering, and the mean area of the austenite grains was determined. The results show that a gamma field delays the decomposition of austenite, owing to preservation of the cohesiveness of the austenite and carbide lattices under irradiation for a longer time than in normal conditions. The rate of coagulation of the carbide is less in irradiated steel, indicating that gamma irradiation promotes the formation of carbide particles with more uniform distribution in the matrix solution. (auth)

9591 METHODS OF DIMENSION CONTROL OF IRRADIATED FUEL TEST SAMPLES IN THE "HOT CELLS." Enderlein, H. pp 77-87 of Reports from the Hot Cells. Karlsruhe, F. R. Germany; GfK (Apr 1974). (In German)

5 figs. Available from the GfK.

A method to investigate the stability of the metal cladding of reactor fuel rods over longer periods of irradiation is dealt with. The verification of the outer measurements of irradiated fuel element single rods, in the development of new types of fuel rods, the controlling of dimensions prior to the beginning and after the ending of the test irradiation, is thus carried out. The most significant changes in measurements are increases in diameter with rods or increases in thickness with plates as a result of the fission gas and fission product pressure formed and of the thermal stress, diameter or thickness decrease due to the attack of corrosion by coolant and fuel, ovalities and bowing with unsymmetrical thermal stress, and locally limited changes of measure at holding positions and changes in length. Part of the basic equipment in the commissioning of the hot cells was a commercial device to measure the diameter of round rods, which is described. (GE)

9592 EFFECT OF A HIGH-CURRENT RELATIVISTIC ELECTRON BEAM ON A METAL. Dmitrenko, B.I.; Leskov, L.V.; Maksimov, G.P.; Nedoseev, S.L.; Savichev, V.V.; Smirnov, V.P.; Spektor, A.M. Sov. Phys.—Tech. Phys. 19: No. 9, 1224-1225 (Mar 1975).

Samples of stainless steel and M—1 copper are irradiated with 55 nsec pulses of 0.8 MeV electrons. The beam current is $\lesssim 25$ kA. For current densities appreciably larger than 1 kA/cm^2 a shock wave is produced in the sample, and splitting is observed on the rear surface. For current densities ~ 1 kA/cm^2 microcavities $\sim 10^{-4}$ cm across are observed in the samples. In the copper samples these are in the form of elongated chains or filaments. The distance between filaments is $\sim 10^{-2}$ cm. Possible causes of the observed phenomena are discussed. (auth)

9593 EFFECT OF A SLOWDOWN IN DIFFUSION OF FISSION XENON IN MOLYBDENUM AT LARGE IRRADIATION DOSES BY FISSION PRODUCTS. Bekmukhambetov, E. S.; Daukeev, D. K.; Zhotabaev, Zh. R.; Ibragimov, Sh. Sh.; Reutova, N. A. (Inst. of Nuclear Physics, Alma-Ata, USSR). Dokl. Akad. Nauk SSSR; 220: No. 5, 1060-1062(11 Feb 1975). (In Russian).

Polycrystalline molybdenum foil 100 micrometers thick was irradiated in a reactor in contact with a layer of fissionable material. The depth distribution of fission ^{133}Xe in the Mo foil was determined by scintillation counting. Part of the irradiated samples saturated with fission products were subjected to diffusion annealing for 50 to 70 h in vacuum at temperatures from 1100 to 1700°C. The diffusion coefficient D was determined as a function of temperature at various fission-product irradiation doses. The data satisfy the following relation: $D = D_0 - \exp(-Q/kT)$. Values of $D_0 \cdot 10^8$ in cm^2/sec and values of Q in kcal/mol at various irradiation doses N (number of fission fragments in 1 cm^3) were found to be respectively: 3.1 cm^2/s and 39.7 kcal/mol at a value of N of $3 \times 10^{15}/cm^3$; 0.8 cm^2/s and 36.8 kcal/mol at a dose N of $1 \times 10^{17}/cm^3$; 0.08 cm^2/s and 30.3 kcal/mol at a dose of $3 \times 10^{17}/cm^3$; and 0.03 cm^2/s and 29.4 kcal/mol at a dose of $3 \times 10^{18}/cm^3$. Here Q is the activation energy, and values of D_0 must be multiplied by 10^{-8}. On plotting values of D as a function of fission-produce dose normalized at small doses to the value of D at T = 1580° it is found that with increasing dose starting at about $10^{16}/cm^3$ the diffusion coefficient decreases. The decrease is greater, the greater the

temperature of the diffusion annealing. This decrease in D with increasing radiation dose is associated with the capture of xenon atoms by vacancy pores. (SJR)

Other Materials

Refer also to abstracts 8547, 8561, 8567, 8574, 9466, 9483, 9518, 9587, 10603, 10609–10611, 10613, 10615, 10643, 10769, 10770, 10843, 10942, 10945, and 11015.

9594 (EFI-61(74)) PHASE TRANSITIONS AT HIGH PRESSURES. Gol'dman, I. I.; Ovnanyan, P. S. (Erevanskij Fizicheskij Inst. (USSR)). 1974. 6p. (In Russian). INIS.

A prediction is made of the existence of a phase transition in a strongly compressed substance from a body-centered structure to a face-centered structure for hydrogen, carbon, and iron. At high densities of the material, where $\rho = l_0/a$ (l_0 is the distance between atoms, and a is the borovskii radius), the total energy of the crystal can be decomposed into a series according to this small parameter: $E/N = (2.87/\rho^2)Z^{\frac{5}{3}} - Z^2\,(G/2\rho) - Z^{\frac{4}{3}}\Delta Z + \Delta_1 \ln(\rho/\rho_1)$. The first term is the kinetic energy of the electrons; the second term is the coulombic energy of the interaction of nuclei in the lattice; the third term is the energy of interaction of electrons with the lattice, and the last term is the energy of the electron-electron interaction. In view of the independence of the type of lattice, this term does not enter into the final result. At very large densities the term $G/2\rho$ is substantial, and the body-centered structure will be stable. However at smaller densities thanks to the term Δ, another structure can turn out to be stable. If the energy curves $E_1(\rho)$ and $E_2(\rho)$ referring to the two different structures intersect at a certain point ρ_0, then $(G_1/2\rho_0) + \Delta_1 = (G_2/2\rho_0) + \Delta_2$. From this: $\rho_0 = -\frac{1}{2}\,(G_1-G_2)/(\Delta_1-\Delta_2)$. It is evident that a phase transition is possible if the signs of (G_1-G_2) and $(\Delta_1-\Delta_2)$ are different. The applicability of the formulas is justified by the smallness of ρ_0: 0.097 for hydrogen; 0.064 for carbon, and 0.039 for iron. (SJR).

9595 (INIS-mf-1635) N. M. R. STUDY OF HYDROGEN DIFFUSION IN URANIUM-HYDRIDE. Peretz, M. (Tel Aviv Univ. (Israel)). Sep 1974. 61p. (In Hebrew). INIS.

43 refs. The research work for this thesis was carried out at the Soreq Nuclear Research Centre under the direction of Prof. D. Zamir.

An N.M.R. study was made of hydrogen diffusion in uranium-hydride. The classical model for diffusion is reviewed. The B.P.P. model, which connects quantities measured in the N.M.R. with the jump frequency of the atoms, is presented. The crystallographic structure of β-UH_3 is described together with physical quantities which are relevant to N.M.R. measurements. Previous results of diffusion parameters are presented and the experimental method used in their derivation is discussed. These results have been obtained by N.M.R. line-width measurements, and as there are inhomogeneous contributions to the line-width, this method seems adequate. The diffusion parameters from measurements of the spin-spin relaxation time T_2, by the spin-echo method are derived. In this method the inhomogeneous contributions are automatically eliminated. T_1 data were used to confirm results for the diffusion constants. The experimental procedure and the diffusion results are presented. Measurements were made on there samples: UH_3, $UH_{2.8}$, $UH_{2.5}$. The results obtained in UH_3 are: E_a (activation energy for diffusion) = (19.25 ± 0.4) kcal/mole, A_0 (pre-exponential factor) = 1.7×10^{15} Hz. A discussion of the results is given. (INIS)

9596 (NRCN-372) MAGNETIC STRUCTURE OF $CsCoCl_3$ AT 4.2°K. Melamud, M.; Pinto, H.; Makovski, J.; Shaked, H. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Dec 1974. 29p. INIS.

31 refs., 7 figures.

The compound $CsCoCl_3$ is paramagnetic at room temperature and belongs to the space group D_{6h}^{4} - $P6_3/mmc$ with two formula units per unit cell ($CsNiCl_3$ type structure). The neutron diffraction of $CsCoCl_3$ powder and single crystal samples were studied as a function of sample temperature. A transition to antiferromagnetism was found at $T_N = 21.5$°K. The magnetic structure determined from the diffraction pattern at 4.2°K is collinear and consists of ferromagnetic ab planes stacked antiferromagnetically along the c axis, with spins parallel to the c axis. The magnetic moment consistent with the diffraction at 4.2°K is 3.0 ± 0.3 and 2.3 ± 0.3 Bohr magnetons per Co^{2+} ion, according to the powder and single crystal data, respectively. The magnetic unit cell is the hexagonal H-cell ($a = \sqrt{3}a_0$, $c = c_0$) with six formula units per unit cell. This structure belongs to the magnetic space group $P6_3'/m'cm'$ (III_{193}^{193} - $P6_3'/m'cm'$). The powder and single crystal data show that the magnetic structure near T_N is different from the magnetic structure at 4.2°K. A discussion of the structure from the point of view of Landau and Lifshitz's theory of second order phase transitions is given. (auth)

9597 (SC-RR-71-0714) IMPROVEMENTS IN THE CHART D RADIATION-HYDRODYNAMIC CODE III: REVISED ANALYTIC EQUATIONS OF STATE. Thompson, S. L.; Lauson, H. S. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 113p. Dep. NTIS $8.75.

A revised set of in-line equation-of-state subroutines for the CHART D hydrodynamic code is described. The information generated is thermodynamically complete and self-consistent. The temperature and density range of validity is large. Solids, liquids, vapors, plasmas, and all types of phase mixtures are treated. Energy transport properties are calculated. The set of subroutines form a package which can easily be included in other hydrodynamic codes. (20 figures) (auth)

9598 OPTICAL EXCITATION OF TRAPPED ELECTRONS INTO CONTINUUM IN NAPHTHALENE SINGLE CRYSTAL. Nakayama, T.; Itoh, N. (Nagoya Univ., Japan). Solid State Commun.; 16: No. 5, 635-638(1 Mar 1975).

Wavelength dependence of the photocurrent in irradiated naphthalene single crystal was measured and a broad band peaked at 1.8 eV was found. This band was ascribed to the transition of a charge carrier trapped by the radical into a continuum. The width of the continuum was determined as $0.63^{+0.3}_{-0.5}$ eV. (auth)

9599 PREFERENTIAL ORIENTATION OF PLANAR $Ni(CN)_4^{2-}$ COMPLEX IONS IN A NaCl LATTICE: EVIDENCE FROM EPR STUDIES. Jain, S. C.; Reddy, K. V.; Reddy, T. R. (Solid State Physics Lab., Delhi). Solid State Commun.; 16: No. 5, 585-587 (1 Mar 1975).

Anomalous intensity distribution in the EPR spectrum from tetragonal $[Ni(CN)_4 \cdot Cl_2]^{5-}$ complex in γ-irradiated NaCl : $Ni(CN)_4^{2-}$ was observed. A detailed EPR study revealed that the planar $Ni(CN)_4^{2-}$ complex preferentially enters the lattice with the plane parallel to the {100} growth planes of the crystal. Consequently, regions in the crystal could be found where the complex ions are predominantly oriented parallel to one of the three {100} planes of the crystal. Possible mechanisms of incorporation of the ions are discussed. (auth)

9600 DIRECT PHASE TRANSFORMATIONS OF BORON NITRIDE AT HIGH STATIC PRESSURES. Frantsevich, I. N.; Balan, T. R.; Bochko, A. V.; Dzhamarov, S. S.; Karyuk, G. G.; Kurdyumov, A. V.; Pilyankevich, A. N. (Inst. of Problems of Materials Science, Kiev). Dokl. Chem. (Engl. Transl.); 218: No. 1-3, 662-663(Sep 1974).

Translated from Dokl. Akad. Nauk SSSR; 218: No. 3, 591-592 (Sep 1974).

Transformations of wurtzite-structure (BN_w) to diamondlike sphalerite (BN_{sp}) and graphitelike (BN_g) were investigated. It was found that of the phase transitions of BN at different pressures and temperatures, wurtzite BN is the low-temperature phase at high pressures. The internal energies of the wurtzite and sphalerite modifications are about the same, and the stability of each is apparently determined by the entropy contribution, which depends on the defect concentration and which increases with an increase in temperature. (auth)

9601 ANNIHILATION OF POSITRONS IN GAMMA-IRRADIATED NaCl AND KBr CRYSTALS. Nagarajan, T.; Ramasamy, P. (Univ. of Madras). pp 102 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27–31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

A systematic investigation was made of angular correlation measurements using untreated and differentially irradiated KBr and NaCl single crystals. The angular distribution curve was found to become progressively narrower with the increase in F center concentration, as determined by spectrophotometry. (auth)

9602 FRACTURE OF BORON–EPOXY COMPOSITE DUE TO IMPACT LOADING. de Rosset, W. S. (Ballistic Research Labs., Aberdeen Proving Ground, MD). J. Compos. Mater.; 9: No. 2, 114-117(Apr 1975).

Experiments were carried out to investigate the response of boron-epoxy composite to impact loading, with primary emphasis on the fracture of this composite. This study showed that cracks are nucleated on internal interfaces and that the crack velocity, as extrapolated from post-test observations, is quite high. In addition, an analysis was carried out to determine the stress level at which damage is first observed. (auth)

9603 CRYSTALLO-HYDRATE FORMS OF URANYL HYDROPHOSPHATE. Kobets, L. V.; Nikanovich, M. V.; Goroshko, L. S.;

Novitskii, G. G.; Sikorskii, V. V.; Umreiko, D. S. (Bellorussian State Univ., Minsk). Zh. Neorg. Khim.; 20: No. 3, 599-603(Mar 1975). (In Russian).

Crystallo-hydrates of di-subsituted uranyl phosphate were studied. It was shown that this compound has two stable forms: $UO_2.HPO_4.4H_2O$ and $UO_2.HPO_4.H_2O$. The water vapor pressures at which these are stable were determined, and the thermal dehydration of these crystalline hydrates was studied by thermogravimetric, differential-thermal, and x-ray analysis. It was shown that in the dehydration process the product $UO_2 \cdot HPO_4 \cdot 4H_2O$ becomes amorphous. (tr-auth)

9604 DOUBLE MOLYBDATES OF POTASSIUM AND THORIUM. Bushuev, N. N.; Trunov, V. K.; Gizhinskii, A. R. (Moscow State Univ.). Zh. Neorg. Khim.; 20: No. 3, 604-607(Mar 1975). (In Russian).

Monocrystals of $K_4TH(MoO_4)_4$ and $K_2Th(MoO_4)_3$ were prepared for x-ray structure studies. The elementary cell parameters of the compounds, formed in the K_2MoO_4-$Th(MoO_4)_2$ system were determined. (tr-auth)

9605 ABSENCE OF PARAMAGNETIC LIMITS FOR $H_{c2\|}$ IN LAYERED SUPERCONDUCTORS WITHOUT INVERSION CENTER. Bulaevskii, L.N.; Rusinov, A.I. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). JETP Lett. 21: No. 2, 66-68 (20 Jan 1975).

It is shown that the reason why the paramagnetic limit of the upper critical magnetic field parallel to the layers is exceeded in the layered superconductors $TaS_2(Py)_{1/2}$ and $NbSe_2$ may be the spin-orbit interaction in a lattice without symmetry center. (auth)

9606 URANYL COMPLEX WITH HYDROXYQUINOLINE. In'kova, E. N.; Zelentsov, S. S.; Arsent'eva, V. P. Zh. Neorg. Khim.; 20: No. 3, 823-826(Mar 1975). (In Russian).

A new uranyl complex of hydroxyquinoline was obtained in which the UO_2:oxide ratio was 1:2. The compound is orange in color and contains three molecules of water in its composition. Based on chemical analysis data, derivatographic measurements, and infrared spectra, suggestions are made concerning the structure of the synthesized compound. (tr-auth)

9607 UNSTABLE INTERMEDIATES. CLII. Radicals in Thallous Nitrate. Symons, M. C. R.; West, D. X.; Wilkinson, J. G. (Univ. of Leicester, Eng.). J. Chem. Soc. (London), Dalton Trans.; No. 7, 553-556(1975).

Exposure of thallous nitrate to ^{60}Co γ-rays at 77° K gave NO_3 radicals which exhibited strong charge-transfer interaction with two equivalent thallous ions and a weaker interaction with two others. Two well defined species were formed, one being lost preferentially on annealing above 77° K. These results are rationalized in terms of the crystal structure of the nitrate. Exposure at room temperature gave NO_2 which again exhibited strong hyperfine interaction with four thallous ions, together with a second species, possibly also NO_2, but in a completely different environment, with one very strongly coupled thallous ion. The thallous hyperfine coupling was essentially isotropic, which indicates that the interaction stems from an electron donation from Tl^+ to the radical, which is the reverse of that normally associated with alkali-metal radical-anion systems. (auth)

9608 OPTICAL WAVEGUIDES IN ION-IMPLANTED ZnTe. Valette, S.; Labrunie, G.; Lizet, J. (Laboratoire D'Electronique Et De Technologie De L'Informatique,). J. Appl. Phys. 46: No. 6, 2731-2732 (June 1975).

Two-dimensional optical waveguides have been implanted in a compound semiconductor, zinc telluride (ZnTe), using protons and boron ions. Propagation constants of Te_0 and TM_0 modes have been measured for several doses of implantation, in the visible ($\lambda = 6328$ Å). Losses in the range 1–3 dB/cm are observed in these first experiments, without any thermal annealing. (auth)

9609 PHOTOCURRENTS AND PHOTOCONDUCTIVE YIELD IN MOS STRUCTURES DURING X IRRADIATION. Farmer, J.W.; Lee, R.S. (Kansas State University, Manhattan, Kansas 66506). J. Appl. Phys. 46: No. 6, 2710-2715 (June 1975).

Photocurrents and photoconductive yield have been studied in the SiO_2 layer of MOS structures during x irradiation. Electrode effects were also studied. The study shows that electron injection into the oxide is not important at low doses and dose rates, but electron injection from electrodes becomes significant when sufficient space charge accumulates in the oxide to reduce the barrier at the Si-SiO_2 interface. The data reported here are consistent with a model where the holes are mobile in SiO_2 but are preferentially trapped at the Si-SiO_2 interface. Photoconductive yield measurements exhibit a field dependence which is inconsistent with a model based on the Onsager theory of geminate recombination. Charge generation due to the dissociation of excitons is suggested as a possible mechanism to account for the observed field dependence of the yield. (auth)

9610 INFLUENCE OF ELECTRON AND ION IRRADIATION ON SOME SURFACE PROPERTIES OF OXIDIZED SILICON. Smushchenko, V.Ya.; Arslambekov, V.A.; Gorbunova, K.M. (Institute of Physical Chemistry, Academy of Sciences of the USSR, Moscow). Sov. Phys.—Semicond. 8: No. 11, 1429-1430 (May 1975).

Samples of oxidized silicon were irradiated with electrons and ions. Using the contact potential method, we have studied the effects of the irradiation on the electrical properties of the silicon surface. (AIP)

9611 REDUCTION IN THE CONCENTRATION OF GOLD RECOMBINATION CENTERS DUE TO ELECTRON IRRADIATION OF GERMANIUM. Boyarkina, N.I.; Smirnov, L.S.; Stas', V.F. (Institute of the Physics of Semiconductors, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.—Semicond. 8: No. 11, 1431-1431 (May 1975).

Using 3.5 MeV electrons, we have studied the effect of irradiation on the concentration of recombination centers in gold-doped germanium. A reduction in the concentration was determined from observation of the annealing temperature. (AIP)

9612 TRITIUM DEPTH PROFILING BY NEUTRON TIME-OF-FLIGHT. Davis, J. C.; Anderson, J. D. (Lawrence Livermore Lab., CA). J. Vac. Sci. Technol.; 12: No. 1, 358-360(1975).

A method has been developed to measure the depth profile of tritium implanted or absorbed in materials. The sample is bombarded with a pulsed proton beam. Neutron energies from T(p,n) reactions occurring in the target are measured by time-of-flight over a 10.8-m flight path. From the neutron energy the proton energy and, thus, the tritium depth in the target may be inferred. The measurements were initiated to determine the depletion of tritium absorbed in titanium layers. These layers had served as targets on a 400-keV T(d,n) neutron generator. A depth resolution of 0.4 mg/cm^2 of titanium (0.9 mu) was obtained. Unlike proton backscattering methods, the technique can be used with thick samples. It is estimated that a sensitivity of 0.1 at. percent tritium in host materials can be obtained. Extension of the method to deuterium depth profiling is possible with the use of the D(d,n) reaction. (auth)

9613 LIGHT HYDROCARBON MOLECULES ABSORBED ON GRAPHITE: EQUILIBRIUM CONFIGURATION AND NORMAL COORDINATE ANALYSIS. Pisani, C.; Ricca, F.; Dovesi, R. (Univ. of Turin). Jap. Appl. Phys.; No. Suppl. 2, 269-274(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

The physisorption of light hydrocarbons on the basal plane of graphite was theoretically studied. Potential energies are calculated in the pairwise approximation, using Lennard-Jones potentials, by summing up all interactions between the carbon atoms in the graphite crystal and the hydrogen and carbon atoms in the adsorbed molecule. Potential minima are determined by a process of simultaneous minimization in the six parameters which define the configuration of the rigid molecule with respect to the graphite crystal. A normal coordinate analysis is then carried out in the harmonic approximation, which proves satisfactory for fundamental and singly excited states. In the cases considered, the residual energy represents an appreciable fraction of the adsorption energy, a large part being due to hindered rotations at the adsorbing surface. (auth)

9614 He MONOLAYER FILMS ON GRAPHITE. Dash, J. G. (Univ. of Washington, Seattle). Jap. Appl. Phys.; No. Suppl. 2, 291-294(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

Recent calorimetric studies of helium monolayers adsorbed on basal plane graphite substrates have disclosed two-dimensional gas, liquid and solid phases as well as an ordered epitaxial array believed to be $\sqrt{3}$ R 30°. Previous failures to observe these phases are ascribed to the heterogeneity of typical adsorbents. The new results suggest several ways in which He films can be used as very sensitive probes of certain properties of solid surfaces. (auth)

9615 ADSORPTION ENTROPY OF RARE GASES ON THE (0001) GRAPHITE FACE. Suzanne, J.; Masri, P.; Bienfait, M. (Univ. Luminy, Marseille). Jap. Appl. Phys.; No. Suppl. 2, 295-298(1974).

From 2nd international conference on solid surfaces; Kyoto, Japan (25 Mar 1974). See CONF-740368-.

An Einstein model is used to calculate the vibrational entropy of adsorption of a krypton or xenon monolayer adsorbed on the (0001) graphite surface. The force constants occuring in the theory are deduced from Lennard Jones interaction laws. The computed value for xenon, $\Delta S \simeq -1.2$ cal mole^{-1} K^{-1}, is compared to the one evaluated from Auger electron spectroscopy data, $\Delta S = -2 \pm 1$ cal mole^{-1} K^{-1}. The vibrations in the adsorbed phase are partly hindered in comparison to the vibrations of atoms of a bulk xenon crystal. For krypton, no experimental value of ΔS

is available, but the computation shows that the vibrations are hindered or amplified according to the direction. (auth)

9616 EFFECT OF X-CENTERS ON THE CREATION OF F-CENTERS BY RADIATION IN ADDITIVELY COLORED CRYSTALS. Gotlib, V.; Itskovich, Z.; Kalnin, J. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 6, 19-22(1974). (In Russian).

The problems of creating the F-centers under the influence of ionizing radiation in additively colored KCl crystals are investigated. It is shown that the presence of the X-centers results in a more intense generation of the F-centers in comparison to those crystals where the X-centers are not involved. The analysis carried out leads to the conclusion that the intensification of the F-center generation is related to the recombination of the H-centers at the X-centers. (auth)

9617 CONNECTION BETWEEN CHARGE-DENSITY WAVES AND SUPERCONDUCTIVITY IN $NbSe_2$. Morris, R.C. (Department of Physics, Florida State University, Tallahassee, Florida 32306). Phys. Rev. Lett. 34: No. 18, 1164-1166 (5 May 1975).

A study of the effect of magnetic impurities and magnetic field on the purported charge-density-wave (CDW) transition in $NbSe_2$ reveals an intriguing connection between the CDW and the superconducting states. Increasing magnetic impurity concentration results in a reduction of the transition temperature for CDW formation identical to the suppression of the superconducting T_C. A magnetic field, on the other hand, enhances the CDW transition. (auth)

9618 PROPERTIES OF INTERCALATED 2H-$NbSe_2$, 4Hb-TaS_2, AND 1T-TaS_2. Meyer, S.F.; Howard, R.E.; Stewart, G.R.; Acrivos, J.V.; Geballe, T.H. (Department of Applied Physics, Stanford University, Stanford, California 94305). J. Chem. Phys. 62: No. 11, 4411-4419 (1 June 1975).

The layered compounds 2H-$NbSe_2$, 4Hb-TaS_2, and 1T-TaS_2 have been intercalated with organic molecules; and the resulting crystal structure, heat capacity, conductivity, and superconductivity have been studied. The coordination in the disulfide layers was found to be unchanged in the product phase. Resistance minima appear and the superconducting transition temperature is reduced in the $NbSe_2$ complex. Conversely, superconductivity is induced in the 4Hb-TaS_2 complex. Corresponding evidence of a large change of the density of states, negative for 2H-$NbSe_2$ and positive for 4Hb-TaS_2, was also observed upon intercalation. The transport properties of all the intercalation complexes show a pronounced dependence upon the coordination of the transition metal. (auth)

9619 SPECTRAL DENSITY FUNCTIONS FOR A $J = 1$ QUADRUPOLAR SOLID: APPLICATION TO SOLID H_2. Myles, C.W. (Battelle Memorial Institute, 505 King Avenue, Columbus, Ohio 43201); Ebner, C. Phys. Rev. B 11: No. 6, 2339-2351 (15 Mar 1975).

Integral equations for the dynamical two-point angular momentum correlation functions of a $J = 1$ quadrupolar solid are derived by the use of a diagrammatic technique which was previously developed for dense magnetic systems. For comparison to experiments on solid mixtures of ortho and para hydrogen, a simple scheme, valid in the high-concentration limit, is used to impurity average these equations. The averaged equations are then solved numerically to obtain the spectral functions for solid H_2 self-consistently for the first time. The resulting spectral functions are then used to compute the nuclear spin-lattice relaxation time of solid H_2 as a function of the ortho-molecule concentration and this is shown to agree well with experiments at 10 K and over a concentration range of $0.5 \leq C \leq 1$. Finally, a formula is derived which expresses the differential inelastic-neutron-scattering cross section in solid H_2 in terms of the calculated spectral functions. If the neutron wave vector and scattering angle are specified, one can then predict the scattering cross section from the numerical results for the spectral functions. (auth)

9620 POINT DEFECTS IN HEXAGONAL BORON NITRIDE. I. EPR, THERMOLUMINESCENCE, AND THERMALLY-STIMULATED-CURRENT MEASUREMENTS. Katzir, A.; Suss, J.T. (Department of Solid State Physics, Soreq Nuclear Research Center, Yavne, Israel); Zunger, A.; Halperin, A. Phys. Rev. B 11: No. 6, 2370-2377 (15 Mar 1975).

When hexagonal boron nitride is exposed to ionizing radiation two types of paramagnetic centers appear: three-boron centers and one-boron centers. Results of electron paramagnetic resonance, thermoluminescence, and thermally-stimulated-current measurements associated with these centers are described, and a model is proposed to explain these results. The model is consistent with views of others investigators on the role of carbon impurities in hexagonal boron nitride, and with the hypothesis that the three-boron centers are *F* centers. The three-boron centers and one-boron centers were found to introduce trapping levels at 1.0 and 0.7 eV, respectively, below the conduction band. It is suggested that carbon impurities produce luminescence centers, with an energy level at about 4.1 eV below the conduction band. Ionizing radiation frees electrons from these levels into the conduction band. Some of the electrons may then be trapped either in three-boron centers or in one-boron centers. Some may fall back to the centers, thus emitting blue photoluminescence. The unpaired trapped electrons give rise to the EPR signals. When the samples are heated, the electrons escape from the traps (first from the one-boron centers and then from three-boron centers and give rise to the glow curves and at the same time also cause a decrease in the EPR signal. This model was supported by quantum-mechanical defect-model calculations, given in part II of this study (following paper). (auth)

9621 ANGULAR-RESOLVED ULTRAVIOLET PHOTOEMISSION SPECTROSCOPY AND ITS APPLICATION TO THE LAYER COMPOUNDS $TaSe_2$ AND TaS_2. Smith, N.V.; Traum, M.M. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 11: No. 6, 2087-2108 (15 Mar 1975).

Photoelectron energy spectra have been measured on the layer compounds 1*T*-$TaSe_2$, 1*T*-TaS_2, and 2*H*-$TaSe_2$ as a function of both polar and azimuthal angle of emission. Light was incident normally upon the sample and the photon energy in most of the experiments was 10.2 eV. The measurements were performed in a specially constructed ultrahigh vacuum chamber using a movable retarding potential-energy analyzer. The variations with polar angle of the positions of peaks in the spectra have been used to plot experimental energy bands which are found to compare favorably with the first-principles calculations of Mattheiss. The azimuthal dependence of the photoemission, and in particular the Ta *d*-emission intensity, was found to display strong anisotropies. X-ray orientation of the 1*T* samples revealed that if one assumes that the Ta *d* photoelectrons originate on Ta atoms, then they propagate preferentially along directions which avoid neighboring chalcogen atoms. The relationship with atomic orbitals and band theory is discussed. In the hexagonal crystal 2*H*-$TaSe_2$, residual threefold rotational symmetry is observed in the Ta *d* emission and is attributed to the shortness of the photoelectron escape depth. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 8440.

9622 (DPSPU-75-30-3) SAFEGUARDS BARREL SCANNER. Wallingford, P. B. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant). May 1975. Contract AT-(07-2)-1. 7p. (CONF-750608-5). Dep. NTIS $4.00.

From annual meeting of the institute of nuclear materials management; New Orleans, Louisiana, USA (18 Jun 1975).

A barrel scanner designed to assay ^{235}U and/or ^{239}Pu in 55-gallon drums filled with low density waste is described. Laboratory tests show that the scanner will measure 5 or more grams of ^{235}U or ^{239}Pu in a drum filled with paper, cloth, or sawdust (density less than or equal to 0.6 g/cm^3) to an accuracy better than +-20 percent of measurement. The complete assay required about 15 minutes, including 8 minutes counting time. The scanner is completely automated and does not require skilled operators. (auth)

9623 (REG/G-5.26(Rev.1)(4-75)) SELECTION OF MATERIAL BALANCE AREAS AND ITEM CONTROL AREAS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Apr 1975. 6p. NRC.

Section 70.58, "Fundamental Nuclear Material Controls," of 10 CFR Part 70, "Special Nuclear Material," requires certain licensees authorized to possess more than one effective kilogram of special nuclear material to establish Material Balance Areas (MBAs) or Item Control Areas (ICAs) for the physical and administrative control of nuclear materials. This section requires that: (1) each MBA be an identifiable physical area such that the quantity of nuclear material being moved into or out of the MBA is represented by a measured value; (2) the number of MBAs be sufficient to localize nuclear material losses or thefts and identify the mechanisms; (3) the custody of all nuclear material within an MBA or ICA be the responsibility of a single designated individual; and (4) ICAs be established according to the same criteria as MBAs except that control into and out of such areas would be by item identity and count for previously determined special nuclear material quantities, the validity of which must be ensured by tamper-safing unless the items are sealed sources. This guide describes bases acceptable to the NRC staff for the selection of material balance areas and item control areas. (auth)

9624 (REG/G-5.32(Rev.1)(5-75)) COMMUNICATION WITH TRANSPORT VEHICLES. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). May 1975. 6p. NRC.

This guide describes radiotelephone equipment and systems, and procedures for their use, that are acceptable to the NRC staff for complying with the Commission's regulations regarding radiotelephone communication in connection with road or rail shipments of special nuclear material. This revision reflects comments received from the public and other factors. (TFD)

9625 (REG/G-5.49(3-75)) INTERNAL TRANSFERS OF SPECIAL NUCLEAR MATERIAL. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Mar 1975. 4p. NRC.

Paragraph 70.51(e) of 10 CFR Part 70 requires, with certain exceptions stated in the rule, that each licensee authorized to possess more than one effective kilogram of special nuclear material (SNM) maintain certain procedures. These procedures are to include: (1) records of the quantities of SNM added to or removed from the process; (2) documentation of all transfers of SNM between material-balance areas to show the identity and quantity of SNM transferred; (3) requirements for authorized signatures on each document used to record the transfer of SNM between material-balance areas; and (4) means for control of and accounting for internal transfer documents. Paragraph 70.58(e) requires licensees to establish, maintain, and follow a system for measuring the SNM transferred between material-balance areas and item-control areas. Paragraph 70.58(f) requires that licensees have a program that evaluates and controls the quality of their measurement system. Additionally, all licensees authorized to possess SNM must comply with paragraph 70.51(b) of 10 CFR Part 70. That rule requires licensees to keep records showing, among other things, the inventory of all SNM in their possession and its location. This guide sets forth acceptable methods for controlling and documenting transfers of SNM within a plant site in order to meet the requirements listed above. (auth)

9626 (SAND-75-5587) PHYSICAL SECURITY SYSTEM EFFECTIVENESS EVALUATION: A STATUS REPORT. Todd, J. L.; Nickell, W. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 10p. (CONF-750607-20). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A method to permit objective comparisons of physical security systems is under development and is expected to be useful in the optimization of system design and in cost benefit analysis. The procedure involves identifying the possible or potential characteristics of a postulated adversary, the counter-measures to deny or diminish adversary success and the response capabilities of the defender. These, in conjunction with system definition information, are evaluated by the use of analytical models which provide a means of ranking systems against threats. The status of this effort and an overview of the methodology with a brief description of various models being considered for use in effectiveness evaluation are discussed. (auth)

9627 (SAND-75-5588) IRRADIATED FUEL BUNDLE COUNTER. Campbell, J. W.; Todd, J. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 8p. (CONF-750607-21). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The design of a prototype safeguards instrument for determining the number of irradiated fuel assemblies leaving an on-power refueled reactor is described. Design details include radiation detection techniques, data processing and display, unattended operation capabilities and data security methods. Development and operating history of the bundle counter is reported. (auth)

9628 (Y-DA-6162) DEVELOPMENT OF A HIGHLY SENSITIVE METAL DETECTOR. Ellis, J. F. (Oak Ridge Y-12 Plant, Tenn. (USA)). 4 Jun 1975. Contract W-7405-eng-26. 12p. (CONF-750607-22). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

One way to detect unauthorized diversion of special nuclear material is to use sensitive radiation detection devices installed at strategic locations in halls and doorways. Nuclear material being carried through one of these detectors would initiate an alarm. One way to avoid detection by a radiation-sensitive device would be to encase the nuclear material in a metallic radiation shield. Rolled lead sheeting would be a prime suspect. Use of walk-through metal detectors is proposed as a means of screening for both shields and special nuclear materials while, at the same time, also providing a way to detect a wide variety of metal objects, which could be hand weapons or devices intended for sabotage. (auth)

9629 (Y-DJ-16513) MUF CONTROL CHARTS AND LEMUF CALCULATIONS USING AN AUTOCORRELATION TECHNIQUE. Johnson, E. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1974. Contract W-7405-eng-26. 11p. (CONF-750608-3). Dep. NTIS $4.00.

From annual meeting of the institute of nuclear materials management; New Orleans, Louisiana, USA (18 Jun 1975).

Standard deviations based on monthly MUFs which are to be used for MUF control charts and LEMUFs should be corrected for the correlation between successive MUFs. The first order autoregression equation as given by Jenkins and Watts in "Spectral Analysis and its Applications" has been applied to MUF data for estimating standard deviation. The construction and interpretation of MUF control charts using the standard deviation corrected for autocorrelation is presented. LEMUFs based on these standard deviation estimates are discussed. Procedures for detecting and omitting deviant results are also presented. (auth)

Disposal and Storage

Refer also to abstracts 8600, 8610, 8613, and 8903.

9630 (NP-20426) NOTE ON STORAGE OF RADIOACTIVE WASTE IN DENMARK. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nov 1974. 30p. (In Danish). Dep. NTIS (US Sales Only) $4.50.

Published in connection with a report on present types of reactors for nuclear power stations, this note deals with radioactive waste disposal in general and in relation to possible future needs in Denmark in particular. Currently known Danish salt deposits seem unsuitable for storage of such wastes. Curves are given for relative toxicity, as ingested or inhaled, of fission products, lead, uranium ore, and the actinides plus radium. (DE)

Handling Equipment and Procedures

Refer also to abstract 10806.

9631 (REG/G-7.3(5-75)) PROCEDURES FOR PICKING UP AND RECEIVING PACKAGES OF RADIOACTIVE MATERIAL. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). May 1975. 10p. NRC.

This regulatory guide describes a method acceptable to the NRC staff for licensees to comply with the provisions in 10 CFR Part 20, section 20.205, with respect to arrangements for receipt, pickup, and monitoring of packages containing radioactive material and with respect to reporting of packages which, on receipt, show evidence of leakage or excessive radiation levels. (TFD)

9632 SHIPMENTS IN THE NUCLEAR FUEL CYCLE PROJECTED TO THE YEAR 2000. Blomeke, J. O.; Kee, C. W.; Salmon, R. (Holifield (Oak Ridge) National Lab., TN). Nucl. News; 18: No. 8, 62-65(Jun 1975).

Some new projections for the nuclear fuel industry with emphasis on shipments of fuel, plutonium, and various types of wastes are presented. Amounts of radioactive wastes accumulated at repositories also are indicated. Earlier projections were based on more optimistic estimates of nuclear power growth than now seem warranted. Future trends in fuel and waste shipping are briefly discussed. (TFD)

Transportation

9633 (ERDA-40) ENVIRONMENTAL IMPACT OF TRANSPORTATION OF NUCLEAR MATERIALS IN THE LMFBR PROGRAM. Excerpts from WASH-1535, "Proposed Final Environmental Statement, Liquid Metal Fast Breeder Reactor Program". (Energy Research and Development Administration, Washington, D. C. (USA)). May 1975. 166p. Dep. NTIS $5.45.

This section presents a general analysis of the predicted environmental impact from the shipment of radioactive materials in the LMFBR fuel cycle. The analysis is based on quantities of materials that would be required to maintain one 1000-MWe LMFBR in operation for one year. The materials considered in this analysis are divided into three categories: unirradiated fuel materials and assemblies, irradiated fuel, and waste. (auth)

9634 FUEL ELEMENT TRANSPORTATION CANISTERS. (to United Kingdom Atomic Energy Authority). British Patent 1,378,681/B/. 27 Dec 1974. Filed date 11 Feb 1972. 5p.

A sealable transportation canister is described for containing fuel elements submerged in a liquid. Self-regulating ullage means are provided so that the free space can be maintained full of the liquid. The fuel elements remain submerged during transportation and accommodation is provided for volume changes in the liquid due to temperature variations. The canister has a primary chamber for containing the fuel elements, a secondary chamber for containing the liquid and pressurized gas with a duct interconnecting the chambers. An air lock provides that the free space can be maintained full of liquid. The secondary chamber may comprise tubes arranged around the primary chamber. (UK)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 9008.

9635 (KFK-EXT-18/75-1) OPERATION OF THE KARLSRUHE ISOCHRONOUS CYCLOTRON IN 1973 AND 1974. Schatz, G.; Schulz, F.; Schweickert, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Zyklotronlaboratorium). Apr 1975. 25p. Dep. NTIS (US Sales Only) $4.25.

The operation of the Karlsruhe Isochronous Cyclotron in 1973 and 1974 is briefly surveyed. The main causes of three short periods for maintenance, repair and installation in these two years are discussed. The status and the results of the following two developments for the cyclotron are described: (1) the axial injection system; and (2) computer aided cyclotron operation. On the occasion of 10 years of operation, some operational statistics of the last years are presented. (auth)

9636 (LA-5856) DESIGN STUDIES OF HEAVY ION LINEAR ACCELERATORS CONSTRUCTED OF INDEPENDENTLY PHASED SPIRAL RESONATORS. Stokes, R. H.; Armstrong, D. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 20p. Dep. NTIS $4.00.

Preliminary design studies are reported for two linear accelerators for heavy ions. One accelerator is a high-intensity machine which would operate with 100 percent duty factor and would produce tin ions with 6.1 MeV/A. Alternatively, it could be operated under pulsed conditions with 25 percent duty factor and would then accelerate uranium ions to 8.1 MeV/A, tin ions to 10.5 MeV/A, and all lighter ions to higher velocities. It would be injected with a positive multicharge ion source and a 4-MV single-ended dc generator. Also, design studies are reported for a small post-accelerator injected by a model FN tandem. Both accelerators use three-drift-tube spiral resonators operating at room temperature. Magnetic quadrupole singlets are placed between all resonators to provide radial focussing. Each resonator is independently phased according to the velocity of the ion to be accelerated. The ability to adjust the phase of each resonator permits variations in final energy and other beam properties with great flexibility. (auth)

9637 (TID-26775) ENVIRONMENTAL MONITORING REPORT FOR CALENDAR YEAR 1974. Baker, S. I. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). 21 Apr 1975. 35p. Dep. NTIS $4.75.

Results of environmental radiation monitoring at the Fermi NAL Synchrotron are presented. The three types of accelerator-produced radiations monitored include penetrating radiation, airborne radioactivity, and waterborne radioactivity. Also, results of evaluation of nonradioactive pollutant releases are presented and discussed. (WHK)

9638 PRODUCTION OF INTENSE MEGAVOLT ION BEAMS WITH A VACUUM REFLEX DISCHARGE. Humphries, S. Jr.; Sudan, R.N. (Cornell University, Ithaca, New York 14850); Condit, W.C. Jr. Appl. Phys. Lett. 26: No. 12, 667-670 (15 June 1975).

Experiments have been carried out using a reflex triode-type pulsed ion accelerator at voltages up to 1.8 MeV. Large reductions in the breakdown electron current drawn by the system resulted from the electron reflexing. Diode closure was the major problem and was strongly affected by the choice of anode materials. The best results were obtained with thin aluminum foil anodes. Over a total accelerating pulse of 130 nsec peak aluminum currents in excess of 5 kA were extracted with a peak energy of Al^{++} of 3 MeV. (auth)

Auxiliaries and Components

9639 (CERN-74-9(Vol.1), pp 85-97) SUPERCONDUCTIVITY. Thomas, D. B. 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

In meeting on technology arising from high-energy physics, CERN, Geneva, 24–26 April, 1974, proceedings. I. Review papers. (European Organization for Nuclear Research, Geneva (Switzerland)).

A short general review is presented of the progress made in applied superconductivity as a result of work performed in connection with the high-energy physics program in Europe. The phenomenon of superconductivity and properties of superconductors of Types I and II are outlined. The main body of the paper deals with the development of niobium–titanium superconducting magnets and of radio-frequency superconducting cavities and accelerating structures. Examples of applications in and for high-energy physics experiments are given, including the large superconducting magnet for the Big European Bubble Chamber, prototype synchrotron magnets for the Super Proton Synchrotron, superconducting d.c. beam line magnets, and superconducting RF cavities for use in various laboratories. (INIS)

9640 (CERN-74-9(Vol.1), pp 120-128) COMPUTER CONTROL APPLIED TO ACCELERATORS. Crowley-Milling, M. C. 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

In meeting on technology arising from high-energy physics, CERN, Geneva, 24–26 April, 1974, proceedings. I. Review papers. (European Organization for Nuclear Research, Geneva (Switzerland)).

The differences that exist between control systems for accelerators and other types of control systems are outlined. It is further indicated that earlier accelerators had manual control systems to which computers were added, but that it is essential for the new, large accelerators to include computers in the control systems right from the beginning. Details of the computer control designed for the Super Proton Synchrotron are presented. The method of choosing the computers is described, as well as the reasons why CERN had to design the message transfer system. The items discussed include: CAMAC interface systems, a new multiplex system, operator-to-computer interaction (such as touch screen, computer-controlled knob, and non-linear trackball), and high-level control languages. Brief mention is made of the contributions of other high-energy research laboratories as well as of some other computer control applications at CERN. (INIS)

9641 (CERN-74-9(Vol.1), pp 146-154) THE HANDLING OF DATA FROM EXPERIMENTS. Davies, H. E. 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

In meeting on technology arising from high-energy physics, CERN, Geneva, 24–26 April, 1974, proceedings. I. Review papers. (European Organization for Nuclear Research, Geneva (Switzerland)).

The use of small computers in on-line experiments in high-energy physics is briefly indicated. The requirement for an above-average performance (data-handling rates up to 1.5 Mbit/sec) is described, emphasizing the problem of data acquisition; data rates and buffering, data storage, and the importance of flexibility are dealt with. The discussion of hardware solutions to the special problems posed by on-line experiments includes the use of CAMAC interfaces, systems of linked computers, and the use of special processors which perform the first steps of data analysis very rapidly. A section on the software solution to data-acquisition problems treats the requirements for flexibility and ease of use, giving as an example a comparison of a manufacturer-supplied Editor and CERN's ORION Editor, and concludes with an outline of the need for direct access to more powerful computers, giving as an illustration the FOCUS and Omega/SFM networks. (INIS)

9642 (LA-tr-75-17) DESIGN OF BEAM HARMONIC MONITOR. Lomize, L. G.; Rubtsov, B. A.; Shmidt, A. V. Translated by A. D. Cernicek from Tr. Radiotekh. Inst.; No. 16, 260-273 (1974). 28p. Dep. NTIS $4.50.

This study carries out calculations of a cylindrical resonator excited by a beam of bunched charged particles which pass through the resonator. Connections of a resonator with external circuits are taken into account. Special attention is paid to field distribution in an aperture through which the beam traverses. Cumbersome electrodynamic calculations are improved by elementary relations and universal diagrams allowing the effect of an opening both on the sensitivity of a sensor as well as on the nature of the interaction distribution with a beam as to its cross-section to be taken into account. (auth)

9643 (LA-UR-75-900) LAMPF EXPERIMENTAL AREA BEAM CURRENT MONITORS. Tallerico, P. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 15p. (CONF-750539-2). Dep. NTIS $4.00.

From 13th symposium on electron, ion, and photon beam technology; Colorado Springs, Colorado, USA (21 May 1975).

This paper summarizes the design and operating results of a wide-range current monitor system used to measure charged-particle currents in the experimental areas of the Clinton P. Anderson Meson Physics Facility (LAMPF), a proton accelerator. The major features of the system are high sensitivity, wide dynamic range and the ability to withstand high levels of radiation.

The current pulses detected are from 50 mu s to 1 ms in duration at repetition rates of from 1 to 120 Hz. The pulse amplitude varies from 1 mu A to 17 mA of protons or H^- ions. Both real-time and integrated outputs are available, and the minimum detectable currents are 1 mu A at the video output and 50 nA at the integrated output. The basic system is comprised of toroids, preamplifiers, signal conditioners, voltage-to-frequency converters, and digital accumulators. The entire system is spread out over 1 km of beam pipe. Provision is made for calibration and for sending the outputs to remote users. The system is normally controlled by a small digital computer, which allows the system to be quite flexible in operation. The design features of the toroids and the associated electronics are discussed in detail, with emphasis on the steps taken to reduce noise and make the toroids temperature and radiation resistant. (auth)

9644 MAGAZINE FOR HANDLING STRIPPING FOILS IN A PARTICLE ACCELERATOR. Gorka, A. J. Jr. (to U.S. Atomic Energy Commission). US Patent 3,867,704. H05h7/00. 18 Feb 1975. Filed date 30 May 1974. 8p.

PAT-APPL-474,550.

Thin foils for stripping a particle beam are stored in a magazine that is operable remotely to display an individual foil, release it when it is spent, and repeat this process. The magazine is operable in the high-vacuum, high-radiation environment in the interior of a particle accelerator, and it uses the magnetic field of the accelerator to operate the display and dropping mechanism. (auth)

9645 MOVING FOIL STRIPPER FOR A PARTICLE ACCELERATOR. Gorka, A. J. Jr. (to U. S. Atomic Energy Commission). US Patent 3,866,132. H05h7/00. 11 Feb 1975. Filed date 30 May 1974. 8p.

PAT-APPL-474,556.

Thin foils for stripping a particle beam are stored on the edge of a disk spinning in the accelerator vacuum. Cutting a foil at one edge releases the foil to project beyond the disk for insertion into the beam at a time determined by controlling the phase of the disk. A wiper removes a spent foil from the disk. The foil release and wiper are operable from a remote location. (auth)

Ion Sources and Injection and Extraction Systems

9646 (KFK-2058) TRANSVERSE AND LONGITUDINAL BEAM MATCHING TO A SUPERCONDUCTING LINEAR PROTON ACCELERATOR. Zieher, K. W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik; Karlsruhe Univ. (TH) (F. R. Germany)). Dec 1974. 100p. (In German). INIS.

A superconducting prototype linear accelerator for protons is being built at the Institut fuer Experimentelle Kernphysik der Universitaet and of the Kernforschungszentrum at Karlsruhe. A high voltage cascade generator with a duoplasmatron source for protons is available as an injector. A transverse and longitudinal beam matching system has been developed and investigated both experimentally and theoretically. The phase space volume of the experimental beam pulses fits into the given transverse and longitudinal acceptance of the linear accelerator. The principle of chopping the beam is different from the conventional method. Both measurements and calculations show that beam pulses can be produced according to this principle which occupy a longitudinal phase space volume smaller than the known theoretical lower limit for a conventional chopper. (auth)

9647 CYCLOTRON INTERNAL ION SOURCE WITH DC EXTRACTION. Hudson, E. D.; Lord, R. S.; Mallory, M. L. (to U. S. Atomic Energy Commission). US Patent 3,867,705. H05h7/08; H05h13/00. 18 Feb 1975. Filed date 29 Mar 1974. 4p.

PAT-APPL-456,392.

An apparatus is provided for increasing the intensities of heavy ion beams accelerated in isochronous cyclotrons at high harmonics (5th harmonic or greater) of the orbit frequency. The small intensities normally obtained at high harmonics are significantly increased by the addition of a dc ion extraction system to the cyclotron ion source. Use of the dc extraction system has increased beams of $^{40}Ar^{3+}$ on the 5th harmonic and $^{20}Ne^{1+}$ on the 7th harmonic from nanoamperes to microamperes. (auth)

Ion Optics and Field Calculations

Refer also to abstract 9994.

9648 EXPERIMENT ON TRAPPING A STRONG-CURRENT STREAM OF RELATIVISTIC ELECTRONS IN A CLOSED ORBIT. Didenko, A.N.; Petrov, A.V.; Ryabchikov, A.I.; Tuzov, V.A.; Usov, Yu.P. JETP Lett. 21: No. 3, 83–84 (5 Feb 1975).

The beam of the "Tonus" accelerator was trapped in a closed orbit without using external electric and magnetic fields, via the repelling action of a trough-shaped copper screen. The lifetime of the shaped electron ring was 250 nsec at an injection pulse duration 50 nsec. (auth)

9649 MAGNETIC-FIELD TRANSPORT OF A HIGH-CURRENT ELECTRON BEAM. Agafonov, A.V.; Voronin, V.S.; Lebedev, A.N.; Pazin, K.N. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.—Tech. Phys. 19: No. 9, 1188-1192 (Mar 1975).

The steady state of a high-current relativistic electron beam in a homogeneous external magnetic field is analyzed; diamagnetism and space charge are taken into account. The relations between the current and the minimum external field required for beam transport are derived. Currents considerably above the Alfvén limit can be transported by hollow beams. (auth)

9650 COHERENT INSTABILITY OF A BEAM IN A VACUUM CHAMBER WITH AN IRREGULAR BOUNDARY. Masunov, E.S. Sov. Phys.—Tech. Phys. 19: No. 9, 1185-1187 (Mar 1975).

The longitudinal stability of charged-particle beams in accelerators and storage rings is analyzed. A general dispersion relation is derived for the case in which the vacuum chamber has an arbitrary irregularity which violates the azimuthal symmetry of the system. The growth rates are calculated taking account of the interaction of harmonics of the space-charge density waves. The motion of a single beam and of the stimultaneous motion of two beams are analyzed separately. (auth)

Storage Rings

Refer also to abstract 9650.

9651 (BNL-20080) ICAM: THE ISABELLE CONTROL AND MONITORING SYSTEM, GLOBAL OVERVIEW. Dimmler, D. G. (Brookhaven National Lab., Upton, N. Y. (USA)). 22 Apr 1975. 19p. Dep. NTIS $4.00.

A first draft on the definition of the ISABELLE Control and Monitoring System is presented. Emphasis is given on the design strategies and on the proposed architectural concepts. A triangular network has been selected and defined. Some structural consideration of processor and bus structure hardware are given. (auth)

9652 (LA-UR-75-402) BEAM EMITTANCE GROWTH IN A PROTON STORAGE RING EMPLOYING CHARGE EXCHANGE INJECTION. Cooper, R. K.; Lawrence, G. P. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 13p. (CONF-750335-24). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Recently, it has been shown that very large currents can be accumulated in medium energy proton storage rings by multiturn injection of an H^- beam through a charge stripping medium. Since the particles are injected continuously into the same phase space, it is possible to increase the circulating beam brightness with respect to that of the incoming beam by a large factor. The stored protons pass repeatedly through the stripper, however, so that this phase space is gradually enlarged by scattering. The dependence of the circulating beam phase space (emittance) growth rate on the nature of the scattering process and on where it occurs in the storage ring matrix is considered. Since the motivation for this work arose in connection with the design of the proposed high-current storage ring at LAMPF, the results are focused on the specific parameters of that device. (WHK)

9653 (LBL-3375) HIGH PERFORMANCE MAGNET POWER SUPPLY OPTIMIZATION. Jackson, L. T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 12 Mar 1975. Contract W-7405-ENG-48. 5p. (CONF-750335-62). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Three types of magnet power supply systems for the joint LBL-SLAC proposed accelerator PEP are discussed. The systems considered include a firing circuit and six-pulse controlled rectifier, transistor systems, and a chopper system. (WHK)

9654 (RL-75-056) MODIFICATION TO THE INJECTION SCHEME FOR EPIC. Gray, D. A. (Science Research Council, Chilton (UK). Rutherford Lab.). Mar 1975. 2p. Dep. NTIS (US Sales Only) $4.00.

The application to EPIC of the Cornell scheme for filling electron-positron storage rings from a synchrotron is summarized. Some parameters for the new scheme are given, and some of the changes that would be necessary in the present proposed design for EPIC. (UK)

9655 CRYOSORPTION PUMPING FOR INTERSECTING STORAGE RINGS. Halama, H. J.; Aggus, J. R. (Brookhaven National Lab., Upton, NY). J. Vac. Sci. Technol.; 12: No. 1, 532-535(1975).

The pumps selected for storage ring vacuum systems must efficiently pump helium and hydrogen at pressures below 10^{-10} torr. In addition, they have to work in a background of nuclear radiation. The presence of an ample supply of liquid helium in the proposed Intersecting Storage Accelerator (ISABELLE) makes cryosorption pumping very attractive. We have investigated, therefore, the behavior of Linde Type 5A molecular sieve, bonded to a stainless steel panel, at 4.2 and 5^{0}K in the pressure range from 10^{-11} to 10^{-8} torr. By fitting our experimental data, we obtained the constants K and B in the equation theta equals K exp(- epsilon^{2}B) which can be used to calculate the adsorption isotherms for helium and hydrogen on bonded molecular sieve 5A at various temperatures. Furthermore, we have determined the causes of a steeper slope of the isotherms in the 10^{-11} torr range. Finally, a pump containing a cryosorption panel was exposed to a flux of 1.7×10^{5} protons and pions per second which resulted in no pressure change. A cryosorption pump was designed which can be operated at 4.2^{0}K either inside or outside the superconducting magnet dewars. (auth)

9656 ISABELLE: SUPER ENERGY p-p COLLIDING BEAMS. Rau, R. R. (Brookhaven National Lab., Upton, NY). Comments Nucl. Particle Phys.; 6: No. 2, 47-53(Apr 1974).

The history of high energy colliding beam experiments is summarized, followed by consideration of why there is an increasing interest in colliding beams and storage ring machines. Then follows a description of the large colliding beam machine, "Isabelle", at Brookhaven National Laboratory, involving proton-proton collisions at 200 GeV. A feature of this machine is the use of superconducting dipole magnets in order to provide much higher magnetic fields and to allow substantially lower operating power costs. The AGS machine will act as injector at 30 GeV and two stored beams will be slowly accelerated to the desired energy. The straight sections of the machine will be long and suitable for meeting a variety of experimental needs. It would appear quite feasible to observe interactions with cross sections lower by two or three orders of magnitude would be observable with the ISR machine. The machine has reached a well defined design state. The design calls for two storage accelerator rings stacked one on top of the other, each ring having a circumference of 2623 m. The maximum circulating current in each beam will be limited to 15 amp. (8×10^{14} protons). Work on superconducting magnets is also summarized. (UK)

Experimental Facilities

Refer also to abstracts 8440, 9007, and 10043.

9657 (CEA-N-1782) DEVICE FOR MONITORING THE BEAM PROFILE IN FRONT OF MIRABELLE. Beauval, J. J.; Bernard, J.; Comby, G.; Deregel, J.; de Lignieres, H.; Mangeot, P.; Marelli, P.; Martin, H.; Rousseau, J.-M.; Sawine, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). 26 Nov 1974. 32p. (In French). INIS.

The apparatus consists of an assembly of multiple-wire proportional chambers, placed a few metres in front of the bubble chamber Mirabelle on the beam axis. It is used to check the presence of the beam, the horizontal centering and vertical distribution, and the stability of the number of particles forming the beam. Its analysis surface more or less covers the surface of the Mirabelle inlet window. Its electronic system enables the particle distributions along two perpendicular axes to be observed visually in control rooms. The apparatus has given very satisfactory results on the total analysis and continuous supervision of the beam. Some changes are foreseen in order to refine the analysis and increase its flexibility of use. (FR)

9658 (CERN-74-9(Vol.1), pp 155-166) SYNCHROTRON RADIATION. Kunz, C. 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

In meeting on technology arising from high-energy physics, CERN, Geneva, 24-26 April, 1974, proceedings. I. Review papers. (European Organization for Nuclear Research, Geneva (Switzerland)).

The production of synchrotron radiation as a by-product of circular high-energy electron (positron) accelerators or storage rings is briefly discussed. A listing of existing or planned synchrotron radiation laboratories is included. The following properties are discussed: spectrum, collimation, polarization, and intensity; a short comparison with other sources (lasers and x-ray tubes) is also given. The remainder of the paper describes the experimental installations at the Deutsches Elektronen-Synchrotron (DESY) and DORIS storage rings, presents a few typical examples out of the fields of atomic, molecular, and solid-state spectroscopy, and finishes with an outlook on the use of synchrotron radiation in molecular biology. (INIS)

9659 THE EXPERIMENTAL PROGRAMME AT TRIUMF. Measday, D. F. (British Columbia Univ., Vancouver (Canada)). pp 423-426 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A brief statement of the main characteristics of TRIUMF is followed by a status report of the major components. The experimental facilities are surveyed and an outline is given of the initial scientific programme. (auth)

9660 STATUS OF THE EXPERIMENTAL FACILITIES AT SIN. Petitjean, C. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). pp 419-422 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A status report is given of the experimental facilities and the physics program at SIN. The 590 NeV proton accelerator is scheduled to accelerate a first beam later this year. First meson beams will be available in spring 1974. (auth)

9661 STATUS OF LAMPF EXPERIMENTAL FACILITIES. Thiessen, H. A. (Los Alamos Scientific Lab., N. Mex. (USA)). pp 416-418 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The experimental facilities which are being prepared for the Clinton P. Anderson Meson Physics Facility (LAMPF) are briefly reviewed. A status report for each beam line and experimental area is presented, and the latest estimate for the date of initial operation of each is discussed. Operating experience with the accelerator is reviewed. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 9696, 9804, and 9860.

9662 (GSI-tr-25/74) EXPERIMENTS FOR THE DETECTION OF TRACKS OF HEAVY AND SUPERHEAVY ELEMENTS IN METEORITES. Flerov, G. N.; Otgonsuren, O.; Perelygin, V. P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). Dec 1974. 13p. (In German). INIS.

7 figs.; 23 refs. Translated from the Russian report JINR-P7-8135. Lecture, held on the international seminar on particle acceleration and nuclear reaction in the interstellular space, Leningrad, 1974.

The results of experiments on revealing and identifying the tracks of very heavy cosmic nuclei in olivines from pallasite meteorites are presented. For sensitivity calibration, these olivines were bombarded by 5–6 MeV/nucleon Ti, Cr, Fe, Zn, Ge, Kr, and Xe ions. If one assumes the group of tracks longer than 580 μm to be due to nuclei of the region from Th to U, their abundance with respect to Fe is 6.10^{-7} per one Fe nucleus taking into account the fragmentation and retardation processes. The abundance of nuclei with $70 <= Z <= 83$ ($R = 360$–560 μm) appears to be $(2.5 +- 0.8) \times 10^{-6}$ per one Fe nucleus. The analysis made shows that the search and identification of the tracks of superheavy cosmic nuclei should be carried out using crystals located up to 1-2 cm from the preatmospheric surface of meteorites. (GE)

9663 TWO CLASSES OF COSMIC RAY DECREASE. Verschell, H.J.; Mendell, R.B.; Korff, S.A. (Department of Physics, New York University, New York, New York 10003); Roelof, E.C. J. Geophys. Res. 80: No. 10, 1189-1201 (1 Apr 1975).

From an analysis of the time variations during 1968–1971 of the fast neutron flux in the upper atmosphere (mean energy of response to primaries, 1–2 GeV per nucleon) versus those of ground-based neutron monitors we have identified two classes of transient intensity decrease on the basis of differences in their spectral responses, time histories, and flare associations. Type I events are found to be classic Forbush decreases, sharp declines accompanying a geomagnetic storm sudden commencement, following by 1–3 days a large optical flare with radio noise and energetic particle production, whereas type II events are more symmetric in their time histories and are therefore not associated with a particular flare. There are also differences in the spectral responses of the two types. During a type I decrease the flux change of the lower-rigidity cosmic ray particles lags the flux change of the high-rigidity particles both in the decline and in the recovery, tracing out a hysteresis loop. During a type II event, if there is any hysteresis at all, the lower-rigidity primaries tend to 'overrecover' in comparison to the higher-rigidity primaries. Intercomparison of neutron monitor data for median response rigidities from 10 to 30 GV reveals that the spectral response in type II events is softer on the average for low-rigidity (< 10 GV) primaries and harder for high-rigidity (> 10 GV) primaries than that in type I events. Comparison of intermixed sequences of type I and II events with recurrences of active regions reveals an identifiable but complex evolutionary relation between decrease occurrence and active region development. Long-lived (of the order of days) low-energy (< 1 MeV) proton events occur during all but one of the type II events identified, supporting an association with solar active region transits. We interpret type II events as either a subsequent evolution of type I (Forbush decrease) events or a quasi-stationary 'corotating' spatial structure loosely associated with an active region. Therefore both type I and type II decreases occur in intermixed recurrence series at intervals of 20–30 days. (auth)

9664 THE EVALUATION OF CUTOFF RIGIDITIES AND REENTRANT ALBEDO CALCULATIONS FOR PALESTINE, DALLAS, AND MIDLAND, TEXAS. Shea, M.A.; Smart, D.F. (Air Force Cambridge Research Laboratories, Bedford, Massachusetts 01731). J. Geophys. Res. 80: No. 10, 1202-1208 (1 Apr 1975).

By using the trajectory-tracing technique, cutoff rigidities for Palestine, Dallas, and Midland, Texas, have been calculated as a function of various zenith and azimuth angles. Extensive analysis of the trajectory calculations shows that there is a systematic uncertainty involved in computing the lowest allowed rigidity, and this uncertainty may be a significant fraction of the penumbral width. Continuation of the trajectory-tracing process below the Stormer cutoff allows an evaluation of the reentrant albedo, showing that the average invariant latitude of the guiding center of the trajectory at the albedo origin is the same as the average invariant latitude of the guiding center of the particle trajectory at the detection point. No significant difference in the cutoff rigidities for these locations is found when the external magnetic fields present in the magnetosphere are added to the geomagnetic field of internal origin. (auth)

9665 COSMIC-RAY ALBEDO IN NEAR-EARTH SPACE. Charakhch'yan, G. A.; Bazilevskaya, G. A.; Stozhkov, Yu. I.; Charakhch'yan, T. N. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 346-349(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 411-416(1974).

Data on the intensity of low-energy electrons and albedo photons in near-Earth space are obtained from stratospheric measurements. The intensity of photons ($E \geq 20$ keV) is higher by a factor of 15 to 20 than that of electrons. From the nature of the latitudinal and temporal intensity variations of albedo particles it follows that they are produced mainly by primary particles with $E > 3$ GeV. (auth)

9666 COMPUTATION OF THE INTEGRAL MULTIPLICITY, COUPLING COEFFICIENTS, AND PARTIAL BAROMETRIC COEFFICIENTS OF THE NEUTRON COMPONENT OF COSMIC RAYS BY THE METHOD OF NONORDINARY MARKOVIAN PROCESSES. Dorman, L. I.; Rishe, L. E. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 350-354(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 417-422(1974).

The formalism of discontinuous Markovian processes is used to determine the integral multiplicity, coupling coefficients, and partial barometric coefficients of the neutron component of cosmic rays. To verify the results obtained, they are compared with experimental data on the vertical-latitudinal effects of the neutron component. (auth)

9667 COSMIC RAY ELECTRONS IN THE ATMOSPHERE. Fulks, G. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.); Meyer, P. (Chicago Univ., Ill. Dept. of Physics). J. Geophys.; 40: No. 6, 751-759(Dec 1974).

The energy spectrum of atmospheric secondary electrons was measured at various depths in the atmosphere. The results are compared with calculations by Daniel and Stephens and good agreement between the shapes of calculated and measured spectra are found. The measured intensity of secondary electrons undergoes larger time variations than predicted from the calculations. (orig.)

9668 CONTRIBUTION OF AN INCREASING PROTON–PROTON CROSS SECTION TO STEEPENING OF THE COSMIC RAY ENERGY SPECTRUM. Gaisser, T. K. (Barthol Research Foundation, Swarthmore, PA); Noble, C. J.; Yodh, G. B. J. Phys. G, Nucl. Phys.; 1: No. 1, L9-L12(10 Jan 1975).

Detailed calculations show that only a part of the steepening observed to occur at an energy of approximately 4×10^{15} eV in the cosmic-ray differential spectrum is likely to be attributable to the effects arising from an increasing proton–nucleus inelastic cross section, even if the composition in the region of the break is pure iron. (auth)

9669 STELLAR ORIGIN OF LOW ENERGY COSMIC RAYS. Lovell, B. (Nuffield Radio Astronomy Lab., Jodrell Bank, Eng.). Phil. Trans. Roy. Soc. London, Ser. A; 277: No. 1270, 489-501 (23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

The large solar flares associated with cosmic-ray events release total bolometric energies in the region 10^{24} to 10^{25} J. This is of the order 10^{-5} to 10^{-6} of the normal bolometric energy emission of the Sun. The condition of the M and K type stars when they flare is entirely different; the rate of energy release during the flare is of the same order as the normal energy release of the star in the quiescent condition. Although these dwarf stars are in a markedly different evolutionary condition compared with the Sun recent simultaneous radio and optical observations of the flares have given decisive indications that the physical processes, involving magnetic field collapse of several hundredths of a tesla, must be similar to the flare mechanism in the Sun. Adopting the factor, which has been determined empirically in the case of the Sun, for the conversion of flare energy to cosmic-ray energy, estimates are made of the fraction of galactic cosmic rays which may be generated in the flares on the M and K type stars. It is shown that these stars may be the major source of the galactic cosmic rays for energies from 10^6 to 3×10^9 eV and that the K type stars may contribute one fifth of the total cosmic-ray energy up to 10^9 eV. (auth)

9670 EXTRA-GALACTIC CONTRIBUTION TO THE PRIMARY COSMIC-RAY FLUX. Burbidge, G. R. (Univ. of California, La

Jolla, San Diego). Phil Trans. Roy. Soc. London, Ser. A; 277: No. 1270, 481-487(23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

In previous studies it has been shown that a good case can be made for supposing that a large fraction of the primary cosmic rays is of extragalactic origin. These ideas are reviewed here, and the most recent observations and theoretical suggestions bearing on the problem are described. (auth)

9671 ORIGIN OF COSMIC RAYS. Ginzberg, V. L. (Inst. of Physical Problem, Moscow). Phil. Trans. Roy. Soc. London, Ser. A; 277: No. 1270, 463-479(23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

The origin of the main part of the cosmic rays observed near the Earth is discussed. This includes first of all the choice between galactic and metagalactic models and the source problem. Some remarks about other related topics also are made especially in connection with the prospects for the future research. (auth)

9672 PRIMARY γ-RAYS. Fichtel, C. E. (National Aeronautics and Space Administration, Greenbelt, MD). Phil. Trans. Roy. Soc. London, Ser. A; 277: No. 1270, 365-379(23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

Within the Galaxy, cosmic rays can reveal their presence in interstellar space and probably in source regions by their interactions with interstellar matter which lead to γ rays with a very characteristic energy spectrum. From the study of the intensity of the high energy γ radiation as a function of galactic longitude, it is already clear that cosmic rays are almost certainly not uniformly distributed in the Galaxy and are not concentrated in the centre of the Galaxy. The galactic cosmic rays appear to be tied to galactic structural features, presumably by the galactic magnetic fields which are in turn held by the matter in the arm segments and the clouds. On the extra-galactic scale, it is now possible to say that cosmic rays are probably not at the density seen near the Earth. The diffuse celestial γ-ray spectrum that is observed presents the interesting possibility of cosmological studies and possible evidence for a residual universal cosmic-ray density, which is much lower than the present galactic cosmic-ray density. (auth)

9673 SEARCH FOR COSMIC-RAY ANISOTROPIES. Elliot, H. (Imperial Coll. of Science and Tech., London). Phil. Trans. Roy. Soc. London, Ser. A; 277: No. 1270, 381-393(23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

At the present time there is no generally accepted evidence for any statistically significant anisotropy in the energy range 10^{17} to 10^{19} eV. The upper limits on the possible anisotropy provide strong evidence that these particles are extra-galactic. In that part of the cosmic-ray magnetic rigidity spectrum below ca. 2×10^{11} V the interplanetary magnetic field effectively prevents the detection of anisotropies in interstellar space and the only isotropies measured are associated with the solar wind and its associated magnetic field. In the range of magnetic rigidities extending from 10^{11} to 10^{12} V the cosmic-ray intensity shows evidence for a small anisotropy of about 2×10^{-4} which can be explained as the result of solar motion relative to the average galactic rotation in our neighborhood. When this is removed the residual deviations from the mean intensity preclude any systematic sinusoidal variation greater than 2×10^{-4}. This high degree of isotropy is most easily understood if these particles are members of an extra-galactic population and it is suggested that this extra-galactic component predominates from the highest cosmic-ray energies down the spectrum at least as far as ca. 10^{11} V rigidity. (auth)

9674 LONG-TERM VARIATIONS IN THE COSMIC-RAY FLUX. Lal, D. (Physical Research Lab., Ahmedabad, India). Phil. Trans. Roy. Soc. London, Ser. A; 277: No. 1270, 395-411 (23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

The present-day information on the temporal and spatial variations in the flux and chemical composition of cosmic-ray protons and multicharged nuclei during certain intervals of time, since the beginning of the solar system, is discussed. This information has been deduced on the basis of analyses of isotopic changes and alterations in the crystalline matrix of meteoritic and lunar materials. Most of the samples analyzed were exposed to cosmic radiation during the recent time period, 0 to 10 Ma B. P. and some during 100 to 1000 Ma B. P. Limited data are also available for the time period soon after the formation of solid objects in the solar system, i.e., ca. 4500 Ma B. P., based on analyses of certain meteorites. The cosmic-ray parameters deduced are for the 1 to 3 AU space and are average values for time periods of 10^5 to 10^7 a for protons, α-particles, v.h./v.v.h. nuclei in the kinetic energy interval (1 to 1500) MeV/nucleon. The archaic cosmic-ray data provide information on the long term average features of acceleration of protons and heavy nuclei by the Sun and on the relative contributions of solar particles to the total cosmic-ray particle population at 1 AU. The implications of absence of any marked time variations in the flux and energy spectra of protons v.h. ($Z > 20$) and v.v.h. ($Z > 30$) nuclei are discussed briefly in relation to cosmic-ray sources and propagation. (auth)

9675 SURVEY OF DATA ON PRIMARY COSMIC-RAY NUCLEI ABOVE 10^{14} eV. Hillas, A. M. (Univ. of Leeds, Eng.). Phil. Trans. Roy. Soc. London, Ser. A; 277: No. 1270, 413-428 (23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

Primary cosmic-ray particles, detected by means of the extensive cascades they generate in the atmosphere, have been observed over a continuous range of energies up to 10^{20} eV, and apparently somewhat higher. At energies such that the radius of curvature of their trajectories, if they are protons, as expected, is comparable to our distance from the galactic centre, the arrival directions of 84 observed particles are distributed randomly over the sky. The energy spectrum of the particles shows an anomaly near 10^{15} eV, where the flux is higher than expected by extrapolation of data near 10^{12} eV, and then falls very rapidly (spectral exponent $\gamma \approx 3.5$ at energies just above 4×10^{15} eV). Above 10^{17} eV the flux falls off less rapidly, γ being near 3.0 in the range 10^{18} to 3×10^{19} eV. Extrapolating the flux back to low energies from 10^{18} eV, where the particles are often assumed to be of extra-galactic origin, gives a flux higher than that actually observed at low energies. The best evidence on energies of the large showers indicates that these are above 10^{20} eV, which is greater than the upper limit to which metagalactic protons could survive interactions with microwave photons. There is evidence that many of the most energetic particles (near 10^{18} eV) are indeed protons, but this result is only preliminary. (auth)

9676 EXPLANATIONS OF THE SPECTRAL SHAPE IN THE ENERGY RANGE 10^{14} TO 10^{20} eV. Wolfendale, A. W. (Univ. of Durham, Eng.). Phil. Trans. Roy. Soc. London, Ser. A; 277: No. 1270, 429-442(23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

There is evidence suggesting an increase in slope of the energy spectrum of primary cosmic-ray nuclei at about 3×10^{15} eV. Alternative explanations are advanced for this change, related to diffusion of particles of galactic origin or black body cut-off effects for particles of extra-galactic origin. At higher energies there appear to be particles of energy up to 10^{20} eV. The evidence is examined critically and alternative explanations put forward for the spectral shape in this region. (auth)

9677 COSMIC-RAY NUCLEI UP TO 10^{10} eV/u IN THE GALAXY. Shapiro, M. M.; Silberberg, R. (Naval Research Lab., Washington, DC). Phil. Trans. Roy. Soc. London, Ser. A; 277: No. 1270, 319-348(23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

Of the nuclear cosmic rays arriving in the vicinity of Earth from interstellar space, more than 90% have energies less than 10^{10} eV/u. Some effects of their modulation (including deceleration) in the solar system are briefly discussed. The origin of particles at energies $< 10^7$ eV/u is still obscure. They could be due to stellar explosions or to solar emissions, or perhaps to interaction of interstellar gas with the solar wind. Between 10^8 and 10^{10} eV/u, the composition appears constant to ca. 30% within the statistics of available data. Cosmic rays traverse a mean path length of 6 g/cm^2 in a medium assumed to contain nine hydrogen atoms for each helium atom. Spallation reactions occurring in this medium result in enhancement of many cosmic-ray elements that are more scarce in the general abundances by several orders of magnitude. Cosmic-ray dwell time in the Galaxy seems to be $< 10^7$ years. The source composition of cosmic rays has been derived for elements with atomic numbers $1 < Z < 26$. A comparison with abundances in the solar system implies that the latter is richer in hydrogen and helium by a factor of ca. 20, in N and O by ca. 5, and in C by a factor of ca. 2. Possible interpretations invoke (a) nucleosynthesis of cosmic rays in certain sources, e.g., supernovae, or (b) models of selective injection that depend, e.g., on ionization potentials or ionization cross sections. Calculated isotopic abundances of arriving cosmic rays are compared with the observed values now becoming available, and found to be in general agreement. Recent progress in probing the composition and spectrum of ultra-heavy nuclei is outlined. (auth)

9678 COMPOSITION AND SPECTRA OF PRIMARY COSMIC-RAY ELECTRONS AND NUCLEI ABOVE 10^{13} eV. Meyer, P. (Univ. of Chicago). Phil. Trans. Roy. Soc. London, Ser. A; 277: No. 1270, 349-363(23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

Recent experiments have extended the knowledge of the flux and energy spectra of individual cosmic-ray components to much higher energies than had previously been accessible. Both electron and nuclear components show a behavior at high energy which is unexpected, and which carries information regarding the sources and the propagation of particles between sources and observer. Electromagnetic interactions which are suffered by the electrons in interstellar space should steepen their spectrum, a steepening that would reveal the average lifetime a cosmic-ray particle spends in the galaxy. Measurements up to 1000 GeV show no such steepening. It was discovered that the composition of the nuclear species which is now measured up to 100 GeV/nucleon changes with energy. This change indicates traversal of less interstellar matter by the high-energy particles than by those of lower energy. The experimental evidence and its implication are discussed. (auth)

9679 REMARKS ON THE POSSIBILITY OF PULSAR-INDUCED BUMP IN THE COSMIC RAY SPECTRUM AT 10^{13}–10^{16} eV/PARTICLE. Elbert, J. W.; Larson, M. O.; Lowe, G. H.; Morrison, J. L.; Mason, G. W.; Spencer, R. L. (Univ. of Utah, Salt Lake City). J. Phys., A (London); 8: No. 1, L13-L17(Jan 1975).

A recent suggestion that there is a bump in the primary cosmic-ray spectrum between 10^{13} and 10^{16} eV/particle (possibly protons from galactic pulsars) is considered in the light of its implications for deep-underground muon observations. A calculation based on Feynman scaling is used to make predictions for multiple muon rates for several assumptions of the primary spectrum and composition. It is concluded that a bump with the proposed prominence would be inconsistent with the muon data. (auth)

9680 CONTRIBUTION FROM PULSARS. Wdowczyk, J. (Univ. of Lodz, Poland). Phil. Trans. Roy. Soc. London, Ser. A; 277: No. 1270, 443-451(23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

A detailed review of the information on the primary cosmic-ray spectrum in the energy interval 10^{12} to 10^{16} eV is given. Methods based on the analysis of the secondary cosmic rays in the atmosphere are described and the results are discussed. By using quantitative predictions based on the mechanism suggested by Gunn & Ostriker (Nature, Lond.; 219: 145 (1968)), and experimental information about pulsars, the energy spectrum of primary cosmic rays is obtained. Under the assumption that the confinement time of the cosmic rays at energies around 10^{15} eV is of the order of one million years, the energy spectrum obtained agrees with the experimental observations in the energy interval 10^{14} to 10^{16} eV. Different mechanisms of accelerations are required below and above the stated energies. (auth)

9681 PULSARS AND THE ORIGIN OF COSMIC RAYS. Goldt, T. (Cornell Univ., Ithaca, NY). Phil. Trans. Roy. Soc. London, Ser. A; 177: No. 1270, 453-463(23 Jan 1975).

From discussion on the origin of the cosmic radiation; London, Eng. (20 Feb 1974).

The distribution of pulsars and their main properties are discussed. Spin and magnetic fields provide them with the means of radiating radio pulses, and there are indications that these are due to relativistic particles radiating in magnetic fields. A contribution to the cosmic rays may be produced at the same time, especially by the youngest pulsars. On energetic grounds this could be a large contribution, but the composition expected would be predominantly iron, while the observed cosmic-ray abundances follow rather closely the general abundance distribution of most elements. The best suggestion at the present time is that the apparent shoulder in the general cosmic-ray spectrum seen around 10^{15} eV may represent the addition of the pulsars. In that case this feature should be mainly iron and its spallation products. (auth)

9682 COSMIC RAY SHOWER SIMULATIONS AND THE PRIMARY ENERGY SPECTRUM ABOVE 10^{17} eV. Turver, K. E. (Univ. of Durham, Eng.). J. Phys. G, Nucl. Phys.; 1: No. 1, 134-149(10 Jan 1975).

The consequences of applying the model for air shower development suggested by Gaisser (Nature, Lond.; 248: 122-4 (1974)) to primaries of energy 10^{17} to 10^{18} eV are investigated. It is shown that there is as good agreement between the predictions from this model with observations of average shower characteristics as there was between the observations and earlier simulation data based upon simple models for high-energy interactions. The effects of adopting the Gaisser model on the conversion of observational data to the primary particle energy spectrum are considered. (auth)

9683 INDICATION OF A SIMULTANEOUS MAXIMUM OF TOTAL CROSS SECTION AND AVERAGE INELASTICITY NEAR 30 000 GeV FROM AN INTERPRETATION OF THE TIAN SHAN EXTENSIVE AIR SHOWER EXPERIMENT. Capdevielle, J. N.; Cachon, A. (Observatoire du pic du Midi, Bagneres-de-Bigorre, France). J. Phys. G, Nucl. Phys.; 1: No. 1, 120-133(10 Jan 1975).

Lateral electron distributions of cosmic extensive air showers (EAS) recorded at energies $\leq 10^5$ GeV are not in agreement with constant inelasticity and constant cross section of ultra-high energy interactions. Theoretical analysis indicates that the p–p cross section and inelasticity are either decreasing together from a maximum larger than 56 mb and 0.55 when the energy is rising from 30 000 GeV up to 10^5 GeV, or are decreasing separately from higher maximum values. (auth)

9684 EVIDENCE OF AN ANISOTROPY IN THE ARRIVAL DIRECTION OF COSMIC RAYS WITH ENERGIES ABOVE 10^{19} eV. Krasilnikov, D. D.; Kuzmin, A. I.; Linsley, J.; Orlov, V. A.; R. J. O.; Watson, A. A.; Wilson, J. G. J. Phys., A (London); 7: No. 18, L176-L180(11 Dec 1974).

Evidence is presented that the arrival direction distribution of cosmic rays with energies above 10^{19} eV is not isotropic. Harmonic analyses indicate that there is, prima facie, a first harmonic (amplitude = 44%, chance probability = 2.6%, phase (in right ascension) = 13.3 ± 1.5 h) at declinations above 0^0, and that there is a significant second harmonic (amplitude = 101%, chance probability = 0.2%, phase 7.8, 19.8 ± 1 h) at declinations below -30^0. Supporting evidence from low energy data is also discussed. (auth)

9685 CALIBRATION OF A NEUTRON TELESCOPE AND MEASUREMENT OF THE STRATOSPHERE NEUTRON SPECTRA BETWEEN 70 AND 250 MeV. Kanbach, G. Munich; Technische Univ. (1974). 90p. (In German). INIS.

Thesis.

The particle stream and the angular distribution of the cosmic ray albedo neutrons, producing high energy protons, are measured and found to be in agreement with theory. The experimental arrangement is tested for directional sensitivity and energy resolution using neutron beams. (GE)

9686 ORIGIN OF VERY HIGH-ENERGY COSMIC RAYS. Colgate, S.A. (New Mexico Institute of Mining and Technology, Socorro, New Mexico 87801). Phys. Rev. Lett. 34: No. 18, 1177-1180 (5 May 1975).

It is suggested that a single source of cosmic rays (supernovas) occurring in all galaxies can produce the observed spectrum and the observed anisotropy, and is predictable from supernova shock theory. Below 10^{13-14} eV the source and observed spectrum are the same, $N(>E) \propto E^{-\alpha}$, $\alpha \simeq 1.75$. Above 10^{14} eV I predict a source with $\alpha \simeq 1.2$. Galactic leakage above 10^{15} eV is linear so that $\alpha \simeq 2.2$ as observed. Above 10^{19} eV cosmic rays fill the metagalaxy to a flux several times the anisotropic residual flux from a few events in our galaxy as observed. (auth)

9687 ENERGY LOSS OF RELATIVISTIC ELECTRONS AND POSITRONS TRAVERSING COSMIC MATTER. Gould, R.J. (Department of Physics, University of California, San Diego). Astrophys. J. 196: No. 3, 689-694 (15 Mar 1975).

Energy loss by Compton scattering, bremsstrahlung, electronic excitations, synchrotron radiation, and pair production is evaluated for relativistic electrons and positrons traversing a neutral or ionized gas of atomic hydrogen and helium with a blackbody radiation field and a magnetic field. For a Hubble constant $H_0 = 50$ km s^{-1} Mpc^{-1}, adiabatic expansion is the dominant loss process for particle Lorentz factors $\gamma < 370$. For larger γ, Compton scattering dominates up to about $\gamma = 3 \times 10^{10}$; at energies higher than this, synchrotron radiation is the principal loss process if $B = 10^{-7}$ gauss. Assuming that the observed cosmic X-ray and extragalactic radio background are due to Compton scattering of 2.7°K blackbody photons and synchrotron radiation, respectively, an rms value $\langle B_0^2 \rangle^{1/2} = 0.9 \times 10^{-7}$ gauss is derived for the intergalactic magnetic field at the present epoch. This value is independent of the cosmological model assumed. (auth)

9688 COSMIC-RAY SPECTRA AND HAGEDORN'S THERMODYNAMIC MODEL. Torsti, J. J. (Univ. of Turku, Finland). Nuovo Cim., B; 25B: No. 2, 829-841(11 Feb 1975).

The sea-level muon and proton spectra were computed by using Hagedorn's model for the production of nucleons, pions, and kaons in nucleon–nucleus collisions. The multiplicities and partial inelasticities of these particles were calculated in the range 5 to 40,000 GeV of proton laboratory energy. The predicted muon and proton spectra show agreement ((0 to 20)%) with recent measurements in the range 5 to 5000 GeV. Thus, Hagedorn's model is very useful in cosmic-ray physics. The results also confirm the abso-

lute primary nucleon spectrum, which was built up for this purpose from two recent experimental spectra. (auth)

9689 INVESTIGATION OF THE WAVE FORM OF CERENKOV-RADIATION PULSES FROM EXTENSIVE AIR SHOWERS. Kalmykov, N.N.; Prosin, V.V.; Khristiansen, G.B.; Grigor'ev, V.M.; Pavlov, V.N.; Efimov, N.N.; Krasil'nikov, D.D.; Kuz'min, A.I. (Nuclear Physics Institute, Moscow State University). JETP Lett. 21: No. 1, 30-32 (5 Jan 1975).

Experimental data and calculation results are presented on the duration of a Cerenkov pulse of an EAS in the distance range 200–1000 m. The possibility of determining the composition of the primary radiation, of choosing the model of shower development, and of estimating the range of the nuclear interaction at energies above 10^{17} eV is discussed. (auth)

Stars

Refer also to abstracts 9758, 10235, and 10584.

9690 (IC-74-34) RADIATION FROM COSMIC BLAST WAVES. Bollea, D.; Cavaliere, A. (International Centre for Theoretical Physics, Trieste (Italy)). May 1974. 27p. INIS.

4 figs.; 2 tables; 20 refs.

A study of the dynamics of blast waves, of their internal structure and of the bremsstrahlung radiation from the shocked plasma in conditions when the cooling time is longer than the expansion time. Models appropriate to interpret the x-ray sources associated with supernova remnants and the explosive activity of radiogalaxies in clusters of galaxies are computed and discussed, including the inverse Compton emission from continuously injected relativistic electrons. (auth)

9691 GENESIS AND CLASSIFICATION OF MAGNETIC STARS. I. Drobyshevskii, E. M. (Ioffe Inst. of Physics and Tech., Leningrad). Astrophysics (Engl. Transl.); 9: No. 1, 64-75(1973).

Translated from Astrofizika; 9: No. 1, 119-138(1973).

Ideas relating to the generation of a magnetic field in stars and the relict nature of the field are synthesized. In magnetic stars of the first generation (type) the field is generated in the outer convective zone and is accumulated within the star by accretion of unmagnetized material from outside. These are Am and Sr Ap stars. Magnetic stars of the second generation arise in close multiple systems if a magnetic star of the first type ejects its field together with matter to the second star (type II stars: Cr–Eu Ap stars) or if a more massive component transfers its nonmagnetized matter onto a type I star (type III magnetic stars: Hg–Mn Ap stars). Development of these ideas makes it possible to understand many properties of Am and Ap stars. The origin of anomalies in their chemical composition and the nature of the Asi stars are not considered in this paper. (auth)

9692 STRUCTURE OF THE HORIZONTAL BRANCH AND AGE OF GLOBULAR CLUSTERS. Eigenson, A. M. (Lvov State Univ.). Astrophysics (Engl. Transl.); 9: No. 1, 58-63 (1973).

Translated from Astrofizika; 9: No. 1, 107-118(1973).

The ratio of the number of stars to the blue side of the variable gap to the total number of nonvariable stars of the horizontal branch is compared with other characteristics of globular clusters. It is shown that a more numerous population of the region to the left of the gap corresponds to older clusters. Indications are found that evolution along the horizontal branch occurs in the blue direction. With increasing age, the giant branch becomes steeper and is shifted to the left on the C–M diagram. Simultaneously, the horizontal branch as a whole moves in the blue direction. (auth)

9693 OSCILLATIONS OF A PLASMA IN A MAGNETIC AND A GRAVITATIONAL FIELD. Dolginov, A. Z.; Zelikman, M. A. (Ioffe Inst. of Physics and Tech., Leningrad). Astrophysics (Engl. Transl.); 9: No. 1, 54-57(1973).

Translated from Astrofizika; 9: No. 1, 99-106(1973).

Dispersion relations and branches of low-frequency oscillations of a plasma in a magnetic and a gravitational field are found. It is shown that such oscillations can exist in the plasma of the Sun and stars. (auth)

9694 INCOHERENT SCATTERING. IV. Infinite Medium. Engibaryan, N. B.; Nikogosyan, A. G. (Inst. of Mathematic, Erevan). Astrophysics (Engl. Transl.); 9: No. 1, 41-50(1973).

Translated from Astrofizika; 9: No. 1, 79-94(1973).

The problem of transfer of resonance radiation in an infinite medium was studied as part of a series of papers. The problem is posed under fairly general assumptions concerning the form of the frequency redistribution function in the case when this is assumed to be independent of the scattering angle. In some cases, for example, for the exact redistribution law for Doppler line broadening, the problem can be completely solved. The degree of excitation at different distances from the source and also the distribution of the photon path lengths are determined as a function of the original frequency (the second quantity with allowance for absorption in the continuous spectrum). The results of numerical calculations are given. (auth)

9695 NEW THEORY ON THE GENERATION OF THE MAGNETIC FIELD OF CELESTIAL BODIES. I. General Foundations. Schmutzer, E. (Friedrich-Schiller Univ., Jena). Exp. Tech. Phys.; 22: No. 6, 485-503(1974). (In German).

On the basis of a former paper, in which one could obtain a new force term in the equation of motion and a generalization of the mass continuity equation, taking into account the relativistic effects of the conductive momentum density, the general foundations of a new theory of the magnetic fields of celestial bodies are developed. Maxwell theory, gravitation theory, hydromechanics, and irreversible thermodynamics are taken as fundamentals. The calculations are performed up to the 2nd harmonic. (auth)

9696 ALTERNATIVE HYPOTHESIS FOR THE ORIGIN OF CCF XENON. Black, D. C. (London Univ.). Nature (London); 253: No. 5491, 417-419(6 Feb 1975).

It is suggested that the anomalous Xe isotopic composition known as carbonaceous chondrite fission (CCF) Xe is not due to fission but is the direct result of a modified r-process nucleosynthesis that produces an abundance peak at Z = 54 and the magic neutron number 82. It is also suggested that the Xe so produced was trapped in dust grains that were subsequently incorporated in the solar system with minimal degassing. This hypothesis also provides a natural explanation for the intimate association between "R–Xe" and a newly discovered Xe component in primitive meteorites. The suggestion is examined in detail. (UK)

9697 RAPID VARIATIONS IN THE SPECTRUM OF THE MAGNETIC VARIABLE STAR HD215441. Polosukhina, N. S.; Chuvaev, K. K. (Crimean Astrophysical Observatory, Nauchny, USSR). Nature (London); 251: No. 5477, 693-694(25 Oct 1974).

It is stated that this star has the largest magnetic field recorded (about 34 Kgauss), and varies without change of polarity. Rapid fluctuations of brightness and polarization over a wide spectral range have been observed, and some attempts to detect rapid spectral variations are here described. Observations were made with the 2.6m telescope at the Crimean Astrophysical Observatory during August and September 1973 and January 1974. The spectrograms showed a very complicated spectrum having emission and absorption features, and there were continuous intensity variations of many emission and absorption features, with the shortest time scale of the order of several minutes. The extremely variable emission features point to rapid nonstationary processes on the surface of the star, and it could be that these processes are similar to solar flares. (UK)

9698 LIFETIME EFFECT ON THE SUPERFLUIDITY IN NEUTRON STARS. Itoh, N.; Alpar, M. A. (Cambridge Univ., Eng.). J. Phys., A (London); 7: No. 15, 1970-1976(11 Oct 1974).

A true lifetime effect on the superfluidity in neutron stars due to quasi-particle scattering processes is calculated with the Green function method and is found to lower the superfluid transition temperature by about 20%. This effect constitutes part of the impurity effects on the superfluidity in neutron stars, i.e., it partly arises from the presence of neutrons in the proton superfluid phase and protons in the neutron superfluid phase. (auth)

9699 INTERNAL SOLUTION IN GENERAL RELATIVITY. Krori, K. D. (Cotton Coll., Gauhati, India); Thakurta, S. N. G.; Paul, B. B. J. Phys., A (London); 7: No. 15, 1884-1886(11 Oct 1974).

A solution for the interior metric of a sphere has been obtained with the effective mass density as a variable quantity. (auth)

9700 BLACK HOLES. Stabell, R. (Inst. of Theoretical Astrophysics, Oslo). Fra Fys. Verden; 36: No. 4, 83-87(1974). (In Norwegian).

The gravitational collapse of a star following consumption of the lighter elements by nuclear fusion is shown to lead to the formation of a white dwarf, a neutron star, or a black hole depending on the mass of the star. The meaning of the Schwarzschild radius is explained and some gravitational and relativity phenomena resulting from the formation of a black hole are described. The existence of black holes was first predicted in 1939, and, while it has not yet been possible to identify a black hole with certainty, it is shown that Cygnus X-1 appears to ex-

hibit many of the characteristics to be expected of a black hole. The possible existence of "mini" black holes originating in the Big Bang is mentioned. It is finally pointed out that black holes cannot decrease, only, and inevitably, increase, eventually consuming all matter. (NO)

9701 THEORETICAL COLOURS FOR F AND G SUPERGIANTS. Bell, R. A.; Parson, S. R. (Univ. of Maryland, Baltimore). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 71-78(Oct 1974).

Atomic and molecular line data and the flux constant model atmospheres of Parsons have been used to compute synthetic stellar spectra. These spectra have been convolved with the sensitivity functions of the UBV and uvby systems to yield theoretical colors for stars in the range 6600 K $\geq T_{eff}$ 5400 K, $1.2 \leq \log g \leq 2.4$. These colors may therefore be compared with the observed colors of F–G supergiants and Cepheid variables to obtain data on stellar temperatures, gravities, and abundances as well as interstellar reddenings. (auth)

9702 PHOTOGRAPHIC UBV PHOTOMETRY OF THE GLOBULAR CLUSTER NGC 5927. Menzies, J. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 79-96(Oct 1974).

Color–magnitude and two-color diagrams have been obtained from photographic UBV photometry of 1079 stars brighter than $V = 18^m$ in and near NGC 5927. The color–magnitude diagram consists of a stubby red horizontal branch, a possible asymptotic branch, and a rather flat giant branch, so the cluster probably is a member of the class of relatively metal-rich globulars typified by 47 Tuc. The foreground star density is high but, with the aid of the two-color diagram, it is possible to distinguish between field and cluster stars. Attempts to determine the reddening were inconclusive and in any case it appears to vary across the cluster. A detailed map of the reddening could not be obtained but an apparently uniformly reddened region where $E_{B-V} \approx 0.52$ m was isolated whence the parameters describing the cluster's color–magnitude diagram were found to be $\Delta V = 1.7$ m and $(B-V)_{0\,\mathrm{g}} = 0.92$. (auth)

9703 SOURCE OF FUNCTIONS OF SOME STRONG LINES IN LATE-TYPE STELLAR ATMOSPHERES. Fosbury, R. A. E. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 147-155(Oct 1974).

The classification of the source functions of some strong spectral lines in the atmospheres of late-type stars is discussed. Using Arcturus as an example it is shown that the H_α emission seen in some late-type giants is the result of a photoelectrically controlled source function. In the cool dwarfs however the emission sometimes seen in the Balmer series and some strong neutral metal resonance lines results, like the Ca II H and K emission, from a chromospheric temperature rise coupled with a collisionally controlled source function. (auth)

9704 PHOTOELECTRIC MEASURES OF THE HYDROGEN LINES IN EARLY-TYPE STARS. Feinstein, A. (Observatorio Astronomico, La Plata). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 171-197(Oct 1974).

A description of the results obtained with photoelectric measures through interference filters of the Balmer lines H_α, H_β, and H_γ are presented. Two hundred and ninety-eight objects are listed, including 92 normal stars employed as standards, 133 Be, 41 early B, 17 metallic-line, nine helium-weak, one Cepheid, and five miscellaneous stars. Three satellites of Jupiter and one of Saturn were also measured to infer the same data for the Sun. The early-type emission and nonemission stars were clearly separated from a comparison of the α and β indices. It was found that about 40 per cent of the Be stars display changes in the index from a comparison with older measures obtained by Mendoza or Crawford. It is suggested that an estimate of the emission in Be stars is available through comparison of α and β indices. (auth)

9705 IS THERE A GRAVOTHERMAL CATASTROPHE?. Taff, L.G. (Department of Physics, University of Pittsburgh); Van Horn, H.M. Astrophys. J. Lett. 197: No. 1, L23-L24 (1 Apr 1975).

A study of the thermodynamics of the finite (confined) isothermal sphere led Lynden-Bell and Wood to predict a gravothermal collapse for such systems when the density contrast exceeds a critical value. Here we show that their analysis becomes invalid at precisely this critical point, and that the existence of a gravothermal catastrophe has thus not been proven in their investigation. (auth)

9706 FOSSIL DUST SHELLS AROUND LUMINOUS SUPERGIANTS. Stothers, R. (Institute for Space Studies, Goddard Space Flight Center, NASA, New York). Astrophys. J. Lett. 197: No. 1, L25-L27 (1 Apr 1975).

The observed frequency with which infrared excesses appear in F, G, and K supergiants of luminosity class Ia supports the idea that these excesses arise in a "fossil" circumstellar dust shell that was formed during a prior M-supergiant phase of evolution. The required leftward evolution of the star on the H-R diagram would then imply that the Ledoux, rather than the Schwarzschild, criterion for convective mixing is the correct criterion to use in stellar evolution calculations. (auth)

9707 THE UNUSUAL PERIOD DISTRIBUTION OF RR LYRAE VARIABLES IN THE GLOBULAR CLUSTER IC 4499. Coutts, C. (David Dunlap Observatory, Richmond Hill, Ontario, Canada); Dickens, R.J.; Epps, E.; Read, M. Astrophys. J. Lett. 197: No. 2, L45-L47 (15 Apr 1975).

New periods for 35 RR Lyrae variables in the distant globular cluster IC 4499 have been determined. The mean period of 28 *ab*-type variables is 0.582 ± 0.012, showing that the cluster more closely resembles globular clusters of Oosterhoff group I ($\langle P_{ab} \rangle \sim 0^d.65$) than those of group II ($\langle P_{ab} \rangle \sim 0^d.65$). However, attention is drawn to the possibility and implications of a closer similarity to nearby dwarf spheroidal systems such as Leo II and Draco whose variables have mean periods intermediate between the two Oosterhoff groups. (auth)

9708 A NEW NEARBY SUBDWARF M STAR. Upgren, A.R.; Weis, E.W. (Van Vleck Observatory, Wesleyan University, Middletown, Connecticut). Astrophys. J. Lett. 197: No. 2, L53-L54 (15 Apr 1975).

A recent parallax determination shows that the nearby red dwarf AC+54° 1646–56 lies at a distance of only 6.7 pc. Photoelectric photometry, also recently obtained, shows the star to lie about 1 magnitude below the (M_v, $R-I$) main sequence. Its colors appear similar to those of 20 other M subdwarfs with trigonometric parallaxes. Its tangential velocity is unusually low for a subluminous star, being only 15 km s^{-1}. Its radial velocity has not been determined but would be expected to be high. (auth)

9709 DETECTION OF INTRINSIC LINEAR POLARIZATION IN EMISSION-LINE O STARS. Hayes, D.P. (Department of Astronomy, Columbia University). Astrophys. J. Lett. 197: No. 2, L55-L56 (15 Apr 1975).

Preliminary results of a search for variable linear polarization in ten Of stars are presented. Four of these stars have been found to have variable polarization. It is tentatively concluded that these results may be understood on the basis of spectral classification schemes which attempt to identify the presence of extended envelopes, but further work remains to be done before a correlation between variable polarization and spectral class can be established. (auth)

9710 POLARIMETRY IN THE EMISSION LINES OF SHELL STARS. George, V.; Coyne, S. J. (Univ. of Arizona, Tucson). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 7P-11P(Oct 1974).

Narrow-band polarimetric observations of Zeta Tauri show that in this shell star Hα is polarized only 60 per cent as much as the continuum radiation in adjoining spectral regions. It is concluded that the Hα emission line radiation is unpolarized and must originate in the outer layers of an extended shell. Preliminary narrow-band polarimetry of Zeta Ophiuchi indicates that the polarization of this star must no longer be considered typical of the interstellar medium. (auth)

9711 THE ABUNDANCE OF INTERSTELLAR BERYLLIUM. Boesgaard, A. M. (Centre National de la Recherche Scientifique, 75- Paris (France). Inst. d'Astrophysique). Astron. Astrophys.; 34: No. 1, 9-13(Aug 1974).

The results of a search for interstellar Be from the Be II resonance lines at 3,130, 3,131 in 22 O and B stars are reported. Spectrograms at 3.4 A/mm for 19 stars and at 6.7 A/mm for 3 stars were obtained at the 224-cm telescope at Mauna Kea. Upper limits for the equivalent of a Be II line gives the maximum Be column densities. These are compared directly with Ly-α measures of interstellar H I, where available. In other cases the Ca II doublet ratio method and the interstellar average Ca II/H I value give the Be/H I ratio. The lowest limit on Be/H I found is $\leq 4 \times 10^{-11}$. The four stars with the smallest ratio give an average Be/H I $\leq 7 \times 10^{-11}$. These numbers are comparable to the Be/H ratio found in dwarf G stars. Large molecular hydrogen contents, as indicated by high (B – V) excesses for some of the stars imply that the corrected interstellar Be/H ratio may be $2\text{-}3 \times 10^{-11}$. The corrected average Be/H for seven stars is $\geq 5 \times 10^{-11}$. (orig.)

9712 R-PROCESS NUCLEOSYNTHESIS AND NUCLEI FAR FROM THE REGION OF BETA STABILITY. Kodama, T. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Takahashi, K. Notas Fis., Cent. Brasil. Pesqui. Fis.; 22: No. 12, 229-270(1974).

The gross theory of β-decay is applied to make improved estimates of the absolute magnitude of β-decay half-lives and related variables in the r-process calculation. The time necessary for synthesis seems very likely to be much longer than required by recent studies of the dynamic r process. The abundance calculation is performed with the conventional quasi-static model of Seeger, Fowler and Clayton. The calculation method of the final abundance curve can allow several nuclear processes to interupt β-decay cascades before the β-stability region is reached. The sudden freezing of neutron flux and temperature is assumed to precede these processes. In particular, the effect of β-delayed

neutron emission after freezing is extensively studied. The β-delayed fission is also discussed. The calculated β-strength functions are compared with the recent experimental data obtained at the ISOLDE and OSIRIS facilities. (10 figs, 66 refs) (auth)

9713 OBLIQUE ROTATORS IN BINARY SYSTEMS. Apparao, K. M. V. (Tata Inst. of Fundamental Research, Bombay). Nature (London); 253: No. 5486, 27-28(3 Jan 1975).

Reference is made to the radio pulsar PSR 1913 + 16, which has been identified as a member of a binary system, and to the x-ray "oscillars" Her x-1 and Cen x-3, which are also members of binary systems but are not radio pulsars. The rotating neutron star hypothesis for the compact object in these systems is used to explain observed properties. It is assumed that rotating neutron stars are oblique rotators, that they have magnetic fields, and that the magnetic axes do not coincide with the axes of rotation. (UK)

9714 dB AND gK STARS NEAR THE DIRECTION OF THE GALACTIC CENTER. Hidajat, B.; Radiman, I. (Boscha Observatory, Lembang, Indonesia). Proc., Inst. Teknol. Bandung; 7: No. 2, 77-86(1973).

An objective prism survey of the Palomar-Groningen Variable-Stars Field no. 3 has been undertaken in order to determine the stellar space distribution of dB and gK stars. A concentration of dB stars has been found at the distances between 150 to 250 pcs. The color excess in this direction is found to remain very low. It only reaches 0.12m at r = 0.5 kpc and remains constant thereafter. (auth)

9715 EVOLUTION OF STARS TOWARD THE MAIN SEQUENCE. Hidajat, B. (Bandung Inst. of Tech., Indonesia). Proc., Inst. Teknol. Bandung; 7: No. 3, 119-130(1973).

A review on the knowledge of the stellar evolution toward the main sequence is presented. This is the period during which the stars evolve from the beginning of their formation to the phase of stabilization on the main sequence where nuclear reactions begin to provide the entire energy supply. (auth)

9716 NOTE ON THE FLARE STARS IN THE COALSACK. Hidajat, B.; Kuncoro, A. (Bosscha Observatory, Lemband, Indonesia). Proc., Inst. Taknol. Bandung; 8: No. 3, 125-128 (1974).

The discovery of 5 flare stars in the Coalsack is reported. (auth)

9717 SHOCK-WAVE THERMALIZATION. Colgate, S. A. (New Mexico Inst. of Mining and Tech., Socorro). Astrophys. J.; 195: No. 2, 493-498(15 Jan 1975).

The cooling of the high-ion-temperature precursor of the shock wave in the presumed low-density envelope of a Type II supernova is examined in greater detail for the galactic production of deuterium and some of the other light elements. When the combined effects of a modified ion energy loss rate, modification and inclusion of electron bremsstrahlung, and the truncation of the bremsstrahlung at the Planck limit are taken into account, the cooling time becomes approximately 10T/sub i/ /sup 1/2/ + 30 Thomson scattering periods, where T/sub i/ is the kinetic energy (in MeV per nucleon) of fluid flow behind the shock. This cooling time is roughly a tenfold reduction below the 1973 estimate of Colgate, but fortunately there was a fivefold reduction in the favorable 1974 nucleosynthesis calculations of Epstein, Arnett, and Schramm. In addition, at these shorter cooling times, the photon diffusion from the Planck radiation will limit the precursor phenomenon to shock energies T/sub i/ equal to or greater than 18 MeV per nucleon, so that the overproduction of ^{7}Li, ^{9}Be, and ^{11}B which resulted from the earlier network calculations is greatly reduced. (auth)

9718 DECENTRED DIPOLE MODEL FOR MAGNETIC STARS. Stift, M. J. (Dunsink Observatory, Castleknock, Ireland). Mon. Notic. Roy. Astron. Soc.; 169: No. 3, 471-476 (Dec 1974).

This paper investigates the question whether the decentred dipole model can be applied to all magnetic stars. Several new models are derived for individual stars and it can be shown that this particular oblique rotator model yields satisfactory results for most of the magnetic stars. A detailed discussion of the results cannot confirm the existence of a low-obliquity group among the magnetic stars. (auth)

9719 ACCRETION MODEL OF DWARF NOVAE WITH APPLICATION TO Z CHAMAELEONTIS. Bath, G. T.; Evans, W. D.; Papaloizou, J.; Pringle, J. E. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 169: No. 3, 447-470(Dec 1974).

The processes that arise as a result of mass transfer between the red and blue components in dwarf nova type binary systems are examined. It is shown that the outbursts themselves may be accounted for by unstable mass transfer by the red component. The consequent behavior of the impact hot spot and of the accretion disc surrounding the blue component is shown in the steady state approximation to be in detailed agreement with the observed behaviour of the eclipsing system Z Cha, during both the quiescent normal state, and the outburst state. The cause of such a red component instability is considered together with effects due to time dependent evolution of accretion discs. Problems associated with a nuclear burning instability as an alternative explanation of dwarf nova outbursts are examined. In particular it is shown that the disc behaviour observed in Z Cha is difficult to achieve through such a mechanism. It is noted that many types of variable and unstable stars may involve similar processes to those discussed in this paper. (auth)

9720 RESOLUTION OF BINARY-STAR COMPONENTS. Guseinov, O.Kh.; Mamedov, Ya.A. (Shemakha Astrophysical Observatory, Academy of Sciences of the Azerbaidzhan SSR). Sov. Astron.—AJ 18: No. 5, 662-663 (Mar 1975).

A simple method is described for resolving the components of binary stars, whereby a continuous photographic track of the star is recorded at high speed. (auth)

9721 EFFECTS FROM PROPER MOTIONS OF REFERENCE STARS. Deich, A.N. (Central Astronomical Observatory, Academy of Sciences of the USSR, Pulkovo). Sov. Astron.—AJ 18: No. 5, 646-648 (Mar 1975).

An analysis is made of the influence of measurement errors and the dispersion in the proper motions of reference stars. Observational data are reduced; the dispersion is found to be small and to have practically no effect on absolute stellar proper motions determined with respect to galaxies. An increase in the number of stars measured in a cluster would not diminish any influence from the proper-motion dispersion of the reference stars. The values of the reduction obtained from different galaxies for converting relative to absolute proper motions depend primarily on errors in the measurement of the galaxies, not on the proper-motion dispersion of the reference stars. (auth)

9722 DENSITY VARIATION IN A STAR FIELD TRAVERSED BY A GLOBULAR CLUSTER. Antonov, V.A.; Naumova, E.V.; Ogorodnikov, K.F. (Leningrad University). Sov. Astron.—AJ 18: No. 5, 573-576 (Mar 1975).

The problem of flow around a point mass M (a globular cluster) moving through a homogeneous star field at a constant velocity V_0 is solved on the basis of the hydrodynamic equations of stellar dynamics. An equation is derived for the excess $\Delta\rho$ in the star density projected on the plane of the sky compared to the undisturbed space density ρ_0. The principal characteristic parameter for $\Delta\rho$ is the quantity $2GM/V_0^3$. Hence if the velocity of a globular cluster relative to the local centroid is known, its total mass can be determined from star counts in the neighborhood of the cluster, including the mass of any black hole that might exist at the cluster center. (auth)

9723 THE DYNAMICAL PARAMETER OF STELLAR PHASE DENSITY. Shatsova, R.B. (Rostov-on Don Teachers' College). Sov. Astron.—AJ 18: No. 5, 577-583 (Mar 1975).

The phase-density argument in the generalized ellipsoidal distribution $f(Q+\delta)$, with a quadratic form for the velocity function Q, contains a parameter δ which is very interesting from the viewpoint of stellar dynamics. It has not yet been evaluated, however, because δ cannot be determined from a Schwarzschild velocity distribution. But such a determination is possible for other functions—in particular, a Planck peculiar-velocity distribution. For this case δ is evaluated for type OB, df0-dF4, dM, and dMe stars. The mean value of δ is $\simeq$0.011, approximately the value expected. Numerically, δ is very sensitive to shortcomings in the observed velocity distributions and to details of their analysis, so that the values obtained here are provisional estimates. (auth)

9724 THE OPEN CLUSTER NGC 7789. Koroleva, L.S. (Central Astronomical Observatory, Academy of Sciences of the USSR, Pulkovo). Sov. Astron.—AJ 18: No. 5, 584-589 (Mar 1975).

An investigation is made of the presence of a corona around the open star cluster NGC 7789, and the superposition of a background on the cluster. Within an outer annular zone of width $\Delta r = 5'5$, 86 cluster members have been reliably identified by two criteria; hence one may accept with confidence that a corona exists in this part of the star field. Although the observational data available do not afford a determination of the size of the corona, it does have a quite high density: 0.1 star/$(1')^2$. The composition of the star population is established; two thirds of the "blue stragglers" in the cluster are found to be definite members. The proper motion of the cluster as a whole has been determined and compared with other authors' results. (auth)

9725 MEAN ENERGY DISTRIBUTION IN STELLAR SPECTRA. I. TYPE G, K, AND M STARS. Vasil'ev, O.B.; Zyabrikova, L.V.; Novopashennyi, V.B.; Ruban, E.V. (Central Astronomical Observatory, Academy of Sciences of the USSR, Pulkovo). Sov. Astron.—AJ 18: No. 5, 567-572 (Mar 1975).

The mean spectral energy distribution is calculated for late-type (G, K, M) stars from measurements by various authors at selected wavelengths (3650–10, 700 Å) free of strong absorption features. Tests are made of two methods of statistical analysis applicable to incomplete information and a small sample size; the results are in good agreement. Final least-squares data are given for the mean monochromatic flux of G, K, and M stars outside the earth's atmosphere. These energy distributions are normalized to unity at $\lambda = 5556$ Å. The systematic deviations of individual authors' measurements from the mean photometric system are randomized. Estimates of accuracy are tabulated from the external consistency of different author's measurements rather than from internal evidence. (auth)

9726 CONSTRUCTION OF NEW CENTRAL CONFIGURATIONS OF ARBITRARILY MANY PARTICLES. Nezhinskii, E.M. (Institute of Theoretical Astronomy, Academy of Sciences of the USSR, Leningrad). Sov. Astron.–AJ 18: No. 5, 564-566 (Mar 1975).

By direct construction of two examples, it is shown that three-dimensional self-gravitating central configurations may comprise an unlimited number of particles. (auth)

9727 COLLAPSE OF LOW-MASS STARS AND HEATING BY BETA PROCESSES. Rudzskii, M.A.; Seidov, Z.F. (Shemakha Astrophysical Observatory, Academy of Sciences of the Azerbaidzhan SSR). Sov. Astron.–AJ 18: No. 5, 551-553 (Mar 1975).

In the contraction of relatively "cool" material sufficient energy will be released for a star to be heated to $\simeq 5 \cdot 10^{9}$°K, the temperature at which the "hot" contraction mode begins to operate. Heating will result both from the nonstatic character of beta captures and from electron capture in excited nuclear states followed by emission of γ rays and/or neutrons. During rapid collapse the nuclei can become neutronized with an increase in the atomic weight A. (auth)

9728 RESTRICTED THREE-DIMENSIONAL STELLAR WIND MODELING. I. POLYTROPIC CASE. Nerney, S.F.; Suess, S.T. (Space Environment Laboratory, National Oceanic and Atmospheric Administration, Boulder, Colorado). Astrophys. J. 196: No. 3, 837-847 (15 Mar 1975).

A steady, axisymmetric, nondissipative, three-dimensional solar wind model is investigated through the use of a perturbation expansion in inverse Rossby numbers (the ratio of the Coriolis to the inertial forces). Numerical results are presented for a polytropic gas, although the solutions far from the Sun are independent of this approximation. The meridional velocity at large radius is of order $-2 \sin 2\theta$ km s^{-1}, where θ is the polar angle. This is consistent with the comet-tail analysis of Brandt, Harrington, and Roosen, who find -2.6 ± 1.2 km s^{-1} at 1 a.u. and $\theta = \pi/4$. The meridional magnetic pressure gradient causes mass to be transported away from the equator, creating an apparent sink in the two-dimensional continuity equation there. The mass loss in the equatorial plane is estimated to be a 10–20 percent effect at 5 a.u., growing logarithmically to larger values at greater distances. This illustrates that perturbations that are small everywhere (π_0) may create effects that are competitive with the unperturbed state, indicating that a full nonlinear analysis is needed in these regions. However, this secular growth is so slow that the linearization is probably valid out to the heliosphere. Energy is also channeled from Maxwell stresses into the radial velocity in the equatorial plane. Over the poles, the radial velocity is decreased from spherically symmetric values with a corresponding increase in magnetic flux. (auth)

9729 RADIATIVE TRANSFER IN GRAY CIRCUMSTELLAR DUST ENVELOPES: VY CANIS MAJORIS REVISITED. Schwartz, R.D. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz). Astrophys. J. 196: No. 3, 745-751 (15 Mar 1975).

The circumstellar dust model for VY CMa proposed by Herbig is reinvestigated using a generalized form of Huang's theory of radiative transfer. The resultant envelope parameters and the emergent energy distribution are found to be insensitive to the choice of Eddington factor for a given envelope inner boundary temperature. Observed fluxes from 0.43 to 74 μ are incorporated into the model, and problems relating to grain emissivity for $\lambda > 30$ μ and grain survival at the indicated inner boundary temperature of 1855°K are discussed. (auth)

9730 RADIATIVE TRANSFER IN SPHERICAL CIRCUMSTELLAR DUST ENVELOPES. II. IS THE INFRARED CONTINUUM OF ETA CARINAE PRODUCED BY THERMAL DUST EMISSION? Apruzese, J.P. (Washburn Observatory, University of Wisconsin). Astrophys. J. 196: No. 3, 753-760 (15 Mar 1975).

The radiative transfer techniques of Huang have been further extended in an attempt to construct a specific thermal dust-emission model of η Carinae which fits the observations of both the spectral and the spatial distribution of the infrared radiation. The model which best fits the observations requires infrared emissivities considerably higher than those of normal-size nonsilicate grains. Evidence is presented that the high infrared emissivities are caused by large particles rather than a heavy concentration of infrared-active silicates. The possibility that synchrotron radiation is responsible for some of the infrared continuum is discussed. (auth)

9731 RADIATIVE TRANSFER IN SPHERICAL CIRCUMSTELLAR DUST ENVELOPES. III. DUST ENVELOPE MODELS OF SOME WELL KNOWN INFRARED STARS. Apruzese, J.P. (Washburn Observatory, University of Wisconsin). Astrophys. J. 196: No. 3, 761-768 (15 Mar 1975).

The radiative transfer techniques described elsewhere by the author have been employed to construct dust envelope models of several well known infrared stars. The resulting calculations indicate that the infrared emissivity of circumstellar grains generally must be higher than that which many calculations of small nonsilicate grains yield. This conclusion is dependent to some degree on the (unknown) size of the stellar envelopes considered, but is quite firm in the case of the spatially resolved envelope of IRC+10216. Further observations of the spatial distribution of the infrared radiation from stellar envelopes will be invaluable in deciphering the properties of the circumstellar grains. (auth)

9732 AN ALTERNATIVE MECHANISM FOR PRODUCTION OF EMISSION FEATURES IN SOME INFRARED OBJECTS. Apruzese, J.P. (Washburn Observatory, University of Wisconsin). Astrophys. J. 196: No. 3, 769-771 (15 Mar 1975).

Two dust-envelope models of the M supergiant VX Sgr, which exhibits a prominent emission feature at 10 μ, are presented. The models indicate that, for certain envelope sizes, the presence of the obesrved emission feature does not necessarily indicate that the emitting grains possess a similar feature in their emissivity profile. The mechanism which may in some cases be producing the observed emission feature is discussed. (auth)

9733 NEW BRIGHT HYDROGEN-EMISSION STARS. Irvine, N.J. (Warner and Swasey Observatory, Case Western Reserve University). Astrophys. J. 196: No. 3, 773-775 (15 Mar 1975).

Hα observations of bright, rapidly rotating stars with no history of line emission have led to the discovery of several hydrogen-emission stars and also some possible nonemission shell stars. Suspected variability appears to be a valuable clue in finding new emission stars. (auth)

9734 LINEAR POLARIZATION OF Hα IN Be STARS. Poeckert, R. (Department of Astronomy, University of Western Ontario, London, Ontario, Canada). Astrophys. J. 196: No. 3, 777-787 (15 Mar 1975).

The wavelength dependence of linear polarization across Hα has been measured in 12 Be stars with 2 Å resolution. Shell stars like ξ Tau exhibit a decrease in polarization which is proportional to the strength of the emission component of Hα. Stars considered "pole-on" have no such significant variations in polarization through the emission component. Some stars have substantial interstellar polarization which is indicated by a variation in position angle as well as in percent polarization. The results of this study show that the emission in Hα is unpolarized and therefore must arise in a region of the circumstellar envelope such that the optical depth in electron scattering from that region to the observer is much less than 1. (auth)

9735 ON THE OPTICAL VARIABILITY OF THE HELIUM STARS HD 160641 AND BD +13°3224. Landolt, A.U. (Louisiana State University Observatory). Astrophys. J. 196: No. 3, 789-790 (15 Mar 1975).

UBV photoelectric observations of the helium stars HD 160641 and BD+13°3224 are discussed. A period of 0.107995 days was found for BD+13°3224. (auth)

9736 CARBON IGNITION AND BURNING IN DEGENERATE STELLAR CORES. Couch, R.G. (Center for Nuclear Studies, Department of Astronomy, University of Texas at Austin); Arnett, W.D. Astrophys. J. 196: No. 3, 791-803 (15 Mar 1975).

Earlier calculations (Couch and Arnett 1973*a*, *b*) have been extended and refined. The conditions at ignition of $^{12}C + ^{12}C$ in degenerate carbon-oxygen cores are explored. Nuclear energy release by carbon burning is found to be balanced initially by neutrino loss from Urca shells. Unless the initial ^{13}C abundance is low ($X_c \lesssim 0.1$), a thermal runaway occurs while there is still enough ^{12}C left to power a detonation. The decrease in Y_e (electron abundance per nucleon) arising from electron captures on the products of carbon burning greatly accelerates the evolution of the core to higher densities. This allows the convective core to increase in mass, and thus brings new fuel into the central regions. Nucleosynthesis has been computed with a reaction network of 30 nuclear species (including n, p, α, and e^-); abundances at the point of thermal runaway are presented. Due to the decrease in Y_e (to ~ 0.495 or neutron excess $\eta \simeq 0.01$) the heating and ejection of this matter may *not* give iron-group abundances like those observed in the solar system. Densities at which thermal runaway occurs are far below those currently thought to be necessary for core collapse and hence neutron star formation. Mathematical and astrophysical uncertainties, and the possible relationship between these models and stars, are discussed. (auth)

9737 STUDIES OF EVOLVED STARS. V. NUCLEOSYNTHESIS IN HOT-BOTTOM CONVECTIVE ENVELOPES. Scalo, J.M.; Despain, K.H. (California Institute of Technology); Ulrich, R.K. Astrophys. J. 196: No. 3, 805-817 (15 Mar 1975).

Convective envelopes fitted to the cores of luminous double shell models have been found to develop high base temperatures, (40–80) $\times 10^6$°K, during the period between shell flashes. We show that these "hot-bottom" envelopes are the result of the increasing influence of radiation pressure on the radiative and adiabatic temperature gradients. Lower limits on the luminosity ($M_{bol} \simeq -5.4$) and total mass ($\sim 1.5\,\mathfrak{M}_\odot$) required for the phenomenon are derived; these values depend sensitively on the treatment of the radiative atmosphere and the ionization zones. Light-element nucleosynthesis in hot-bottom envelopes is examined using a convective diffusion model. Large surface ^{7}Li enhancements are produced by the ^{7}Be transport mechanism if the base temperature T_b exceeds 30×10^6°K. Sufficient time before carbon ignition exists for CN processing if $T_b \gtrsim 50 \times 10^6$°K, while full CNO processing and hydrogen depletion may occur if $T_b \gtrsim 75\times10^6$°K. Comparison with observations indicates that nucleosynthesis in hot-bottom envelopes is not the primary cause of the abundance anomalies observed in peculiar red giants, except possibly for the large $^{13}C/^{12}C$ ratios and lithium enhancements found in some stars. In particular, mixing of tripe-α carbon and *s*-process elements initiated by the helium shell flashes seems to be required in order to satisfy constraints imposed by the observed line and band strengths and luminosities. (auth)

9738 THE POLARIZATION SPECTRUM AND MAGNETIC FIELD STRENGTH OF THE WHITE DWARF GRW + 70°8247. Landstreet, J.D. (Department of Astronomy, University of Western Ontario); Angel, J.R.P. Astrophys. J. 196: No. 3, 819-825 (15 Mar 1975).

The wavelength dependence of the circular and linear polarization of the magnetic white dwarf Grw+70°8247 has been obtained with 80–360 Å resolution in the range 0.3–1.1 μ. There is no strong evidence for variability of either circular or linear polarization. The wavelength dependence of circular polarization is interpreted as being due to magnetic circular dichroism in a helium atmosphere. The mean longitudinal field strength estimated from both the circular polarization longward of 4000 Å, which is due to He^- opacity, and from the strong ultraviolet polarization feature, caused by the bound-free opacity, of He^+, is $4–5\times10^7$ gauss. The linear polarization is probably due to a transverse field, estimated at 5×10^7 to 10^8 gauss, again on the basis of He^- opacity. New observations of the absorption feature at 5855 Å are presented, and this is identified with the quadratically shifted π component of the 5876 line of He originating in a lower field region of 1.5×10^7 gauss. (auth)

9739 CATALOG OF EARLY-TYPE STARS MEASURED IN A NARROW-BAND PHOTOMETRIC SYSTEM. Morguleff, N.; Gerbaldi, M. (Inst. d'Astrophysique, Paris). Astron. Astrophys., Suppl. Ser.; 19: No. 2, 189-209(Feb 1975).

A compilation of the photoelectric measurements in the Barber–Morguleff system is presented. The catalog includes data for 773 stars of spectral type 08 to F6. 706 stars were measured at least twice. (auth)

9740 MEMBERSHIP AND PHOTOMETRY OF THE OPEN CLUSTER IC 4756. Herzog, A. D. (New Mexico State Univ., Las Cruces); Sanders, W. L.; Seggewiss, W. Astron. Astrophys., Suppl. Ser.; 19: No. 2, 211-234(Feb 1975).

Probabilities of membership, based on relative proper motions, for 464 stars in the field of IC 4756 are given. The cluster proper motion dispersion (m.e.) of 0.″09 yields 173 probable members. Photographic UBV magnitudes of 471 stars in the field are presented. The color excess of IC 4756 is E (B – V) = $0^m.19$; the apparent distance modulus V – M_v equals $8^m.5$, corresponding to the true distance of 400 pc. The membership probabilities of 6 blue stragglers and of the supergiant HD 172365 (F9 Ib) are discussed. (7 figures, 6 tables) (auth)

9741 OBSERVATIONS OF TWO DELTA SCUTI STARS: HR 1225 AND HR 1298. Joergensen, H. E.; Noergaard-Nielsen, H. U. (Univ. of Copenhagen). Astron. Astrophys., Suppl. Ser.; 19: No. 2, 235-241(Feb 1975).

New observations of HR 1225 and HR 1298 are discussed. Variability of the δ Scuti type is confirmed and the dominating periods are derived. For HR 1225, P = $0^d.1562$; and for HR 1298, P = $0^d.081$. (6 figures, 2 tables) (auth)

9742 SPECTROSCOPIC AND PHOTOMETRIC OBSERVATIONS OF LUMINOUS STARS IN THE CENTAURUS–NORMA (l = 305° TO 340°) SECTION OF THE MILKY WAY. Humphreys, R. M. (Univ. of Minnesota, Minneapolis). Astron. Astrophys., Suppl. Ser.; 19: No. 2, 243-247(Feb 1975).

New observational data are presented for 111 luminous stars in the Centaurus–Norma region of the Milky Way. The new data include MK spectra types and UBV photometry. (1 table) (auth)

9743 IMPROVED COMPLETE-LINEARIZATION METHOD FOR THE SOLUTION OF THE NON-LTE LINE TRANSFER PROBLEM. Hubeny, I. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 26: No. 1, 38-47(1975).

A new numerical method is presented for the self-consistent solution of the radiative transfer equation and the equations of statistical equilibrium. This method enables integrals over frequency in radiative rates to be replaced by quadrature sums of a lower order than previously used. Errors in radiative rates are treated explicitly by introducing an error matrix. An estimate of the elements of the error matrix is obtained, and the matrix can then be used to evaluate a correction to the radiation field in each iteration step of the complete-linearization procedure. The basic matrix size for the complete-linearization method is thus reduced, and more atomic transitions can be treated explicitly. (auth)

9744 MODEL ATMOSPHERE ANALYSIS OF THE PECULIAR STAR 53 AUR. I. The Physical Atmospheric Parameters Determination and Model Atmospheres. Zverko, J. (Astronomical Inst., Skalnate Pleso, Czech.). Bull. Astron. Inst. Czech.; 26: No. 1, 58-63(1975).

The physical atmospheric parameters—the effective temperature, the surface gravity, and the electron density—are determined. The Balmer line profiles are measured, and the Balmer discontinuity is deduced. The corresponding values are as follows: T_{eff} = 10,160°K, log g = 3.90, and log N_e = 14.02. We chose the model atmospheres for the detailed analysis corresponding to these values from Mihalas (1966) and Carbon and Gingerich (1969). (2 figures, 2 tables) (auth)

9745 SPECTROPHOTOMETRIC INVESTIGATION OF THE SPECTROSCOPIC-BINARY STAR α VIRGINIS. Galkina, T. S. Izv. Krym. Astrofiz. Observ.; 47: 83-110(1973). (In Russian).

The complex spectrum of the system alpha Virgo having components B1.2 IV + B3 V is analyzed. The main component of the system is a variable of the type Beta Canis Majoris. On the basis of a large amount of spectroscopic material (228 spectrograms with dispersions of 15 Å/mm in the region of λλ 4950 to 3650 Å and 37 Å/mm in the region of λλ 7000 to 5700 Å), a study was made of the behavior of the intensity and absorption line half-widths of components in the spectrum having phases of an orbital period (4.014 days) and of a short period (4.17 hr). Estimates were made of spectral classes, luminosities, and radii of the components, and a schematic model of the system was constructed. It is shown that the complex structure of the absorption lines in the spectrum of Alpha Virgo and the variability of their intensity can be explained by the instability of the main component in the form of pulsations with a period of 4.17 hr (of the type of Beta Canis Majoris), and also by a disturbance in synchronization of rotation and turning of the ellipsoidal components, and possibly, by the presence of a flow of material in the system. The observational data confirm the hypothesis proposed by O. Struve and developed by Odzhers to explain processes taking place in stars of the type of Beta Canis Majoris. (SJR)

9746 OBSERVATIONS OF THE Li I 6708 A LINE IN SPECTRA OF SOME MAGNETIC VARIABLE STARS. Polosukhina, N. S. Izv. Krym. Astrofiz. Observ.; 47: 118-124(1973). (In Russian).

Changes were noted in the positions of the center of gravity of the line Li I 6708 Å in spectra of the magnito-variable stars Beta Cgu, Gamma Equ, Gamma Vig and Gamma Cap. A shift of the line Li I to the red side was noted in spectra of the magneto-variable stars with respect to its position in spectra of normal stars. Proposals are advanced of possible reasons for this shift. (SJR)

9747 FLARE ACTIVITY OF THE RED DWARF SYSTEM BD + 43° 44AB. Shakhovskaya, N. I. Izv. Krym. Astrofiz. Observ.; 47: 111-117(1973). (In Russian).

During photoelectric surveying for flares in the photometric system close to B a flare activity was detected of the type UV Cet at stars BD + 45° 44 A and BD + 43° 44 B which are components of a visual-binary system. After 40.3 hrs of survey observations of the star BD + 43° 44 A, three flares were recorded. The star BD + 43° 44 B was observed 46.1 hrs, and 16 flares were recorded. Analysis of the spectral observations showed that emission lines H and Ca II, which ordinarily are bright in star spectra of the type UV Cet, are weak or absent in both components of the system BD + 43° 44 AB; their equivalent widths are less than 0.5 to 1.0 Å. Thus the chromospheres of these stars, if they exist, give a bright-line spectrum which on the background of a continuous photosphere emission is at least a factor of 5 to 10 weaker than in flare stars investigated previously. The position of the components of the system on an H-A diagram and the kinematic characteristics show that the age of the system is $\sim10^9$ years. This conclusion proves that flare activity of the type UV Cet can also be extended to old stars. (SJR)

9748 HYDROGEN BURNING OF ^{20}Ne AND ^{22}Ne IN STARS. Rolfs, C.; Rodney, W. S.; Winkler, H. (California Inst. of Tech., Pasadena (USA)); Shapiro, M. H. (California State Univ., Fullerton (USA)). Nucl. Phys., A; 241: No. 3, 460-486(14 Apr 1975).

The ^{20}Ne(p,γ)^{21}Na capture reaction was studied in the energy range E_p = 0.37 to 2.10 MeV. Direct-capture transitions to the 332 ($\frac{5}{2}^+$) and 2425 keV ($\frac{3}{2}^+$) states were found with spectroscopic factors of $C^2S(1d)$ = 0.77 ± 0.13 and $C^2S(2s)$ = 0.90 ± 0.12, respectively. The high-energy tail of the 2425-keV state, bound by 7 keV against proton decay, was also observed in the above energy range as a subthreshold resonance. The excitation function for this tail is consistent with a single-level Breit-Wigner shape for a γ-width of Γ_γ = 0.31 ± 0.07 eV at E_x = 2425 keV. The extrapolation of these data to stellar energies gives an astrophysical S-factor of S(0) = 3500 keV.b. Two new resonances at E_p = 384 ± 5 and 417 ± 5 keV were observed with strengths of $\omega\gamma$ = 0.11 ± 0.02 and 0.06 ± 0.01 meV, corresponding to the known states at $E_x(J^\pi)$ = 2798 ($\frac{1}{2}^-$) and 2829 keV (presumably $\frac{3}{2}^+$), respectively. For the known E_p = 1830-keV resonance, a strength of $\omega\gamma$ = 1.0 ± 0.3 eV and a total width of Γ = 180 ± 15 keV were found. Branching ratios as well as transition strengths were obtained for these three states. The Q-value for the ^{20}Ne(p,γ)^{21}Na reaction (Q = 2432.3 ± 0.5 keV) as well as excitation energies for many low-lying states in ^{21}Na were measured. No evidence was found for the existence of the state reported at E_x = 4308 ± 4 keV. In the case of ^{22}Ne(p,γ)^{23}Na, direct-capture transitions to six final bound states were observed revealing sizeable spectroscopic factors for these states. The astrophysical S-factor extrapolated from these data to stellar energies, is S(0) = 67 ± 12 keV.b. The astrophysical as well as the nuclear structure aspects of the present results are discussed. (auth)

9749 NUCLEAR PHYSICS, NEUTRON STARS AND THE PROPERTIES OF MATTER AT HIGH DENSITIES. Baym, G. (Illinois Univ., Urbana (USA). Dept. of Physics). pp 436-444 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The theory of the properties of matter at high densities is reviewed including recent developments in the questions of the structure of nuclei in neutron star matter; possible solidification of neutron matter under high pressure; condensation of pions into a single microscopic mode, a possible new state of superfluidity of matter; and hyperonic matter. The relation to the structure of neutron stars is discussed. Attempts to determine the equation of state at ultrahigh densities, and their astrophysical applications are considered. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 8985, 9679–9681, 9713, 9862, and 10708.

9750 PHOTOELECTRIC PHOTOMETRY OF OH471 AND OQ172, AND OTHER OPTICAL OBJECTS NEAR RADIO SOURCES. Wills, B. J. (Univ. of Texas, Austin). Nature (London); 251: No. 5477, 691-693(25 Oct 1974).

Some studies are reported of broadband colors for a small group of optical objects associated with radio sources, and identified at the University of Texas Radio Astronomy Observatory, and the colors are compared with the findings of previous studies. The increased reddening of QSO's with increasing redshift is also discussed. The observations were made with two photometer systems on the 82 in. Struve reflector at the McDonald Observatory. (UK)

9751 EXISTENCE AND STABILITY CRITERIA FOR CIRCULAR GEODESICS IN THE VICINITY OF A REISSNER–NORDSTROEM BLACK HOLE. Armenti, A. Jr. (Villanova Univ., PA). Nuovo Cim., 25B: No. 1, 442-448(11 Jan 1975).

Circular timelike geodesics in the vicinity of a Reissner–Nordström black hole of mass m and charge q are considered. These geodesics exist for all $r > (3m/2)\,[1 + (1 - 8q^2/9m^2)^{1/2}]$, and are stable for all $r > r_s$, where r_s is the largest real root of $r^3 - 6mr^2 + 9q^2r - 4q^4/m = 0$. For $q^2 = 0$ these expressions reduce to the familiar Schwarzschild results r > 3m and r > 6m, respectively; for $q^2 = m^2$ they reduce to r > 2m and r > 4m. (auth)

9752 POLARIZATION OF RADIO SOURCES AT LAMBDA 31 cm. Haves, P.; Conway, R. G.; Stannard, D. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 117-131(Oct 1974).

Measurements are presented of the integrated polarizations and flux densities of 226 extragalactic radio sources at λ 31 cm. Four sources with flat radio spectra have varied significantly in both polarization and total intensity over a period of one year. (auth)

9753 STRUCTURE OF IONIZATION FRONTS IN H II REGIONS. Schmidt, E. G. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 97-116 (Oct 1974).

Spectra have been obtained of bright rim structures in four nearby emission nebulae, NGC 1976, NGC 2264, NGC 6820, and IC 1396. These spectra have been calibrated to give relative line strengths and the ratio of the [O II] λ 3727 doublet has been measured. The Balmer decrement is found to be quite constant across the bright rims indicating that collisional excitation is not important and that the internal reddening is fairly constant. From the Balmer decrement the reddening of the objects is determined and the forbidden lines are used to obtain the variation of the electron density, electron temperature, and level of ionization across the bright rims. This data compared with theoretical calculations by Pottasch. It was found that the densities at the ionization fronts agree with the calculations but the variation of density across the rims differs from the theory in one case. The electron temperatures are much cooler than the theoretical values. Consideration of the bright rim in the Orion Nebula indicates that there is a hidden source of excitation in an obscured region to the south-east of the nebula. Data on the bright rim in NGC 2264 indicates that there is no connection between it and an infrared source in this region. (auth)

9754 OBSERVATIONS OF THE SUPERNOVA REMNANT HB21 AT 1.4GHz. Hill, I. E. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 59-69(Oct 1974).

A map with a resolution of 3.0′ × 3.9′ arc at 1.4 GHz of the supernova remnant HB21 is presented. The overall source structure is found to be adequately described by a thick shell model although there are regions where the shell is thin and unresolved. An upper limit of 7 per cent is placed on the polarization at this frequency. Possible emission mechanisms for a thick shell source of this type are discussed. (auth)

9755 OPTICAL OBSERVATION OF STARS NEAR COPERNICUS X-RAY POSITIONS. Murdin, P.; Penston, M. J.; Penston, M. V.; Glass, I. S.; Sanford, P. W.; Hawkins, F. J.; Mason, K. O.; Willmore, A. P. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 25-34(Oct 1974).

The X-ray source 3U 0614 + 09 is identified with a faint blue variable star resembling Sco X-1. A flare star is found in the field of the X-ray source 3U 1636-53 which is a promising candidate for identification. Results of searches for variable or infrared stars in the fields of four other x-ray sources are also given. (auth)

9756 COSMIC-RAY PRODUCTION IN THE CASSIOPEIA A SUPERNOVA REMNANT. Scott, J.S. (Kitt Peak National Observatory); Chevalier, R.A. Astrophys. J. Lett. 197: No. 1, L5-L8 (1 Apr 1975).

A model for the production of high-energy particles in the supernova remnant Cas A is considered. The ordered expansion of the fast moving knots produces turbulent cells in the ambient interstellar medium. The turbulent cells act as magnetic scattering centers, and charged particles are accelerated to large energies by the second-order Fermi mechanism. Model predictions are shown to be consistent with the observed shape and time dependence of the radio spectrum, and with the scale size of magnetic field irregularities. Assuming a galactic supernova rate of one per 50 years, this mechanism is capable of producing the observed galactic cosmic-ray flux and spectrum below 10^{16} eV per nucleon. Several observed features of galactic cosmic rays shown to be consistent with model predictions. (auth)

9757 EVIDENCE FOR A COMPACT SOURCE OF SOFT X—RAYS IN THE CYGNUS LOOP. Bleach, R.D. (E. O. Hulburt Center for Space Research); Henry, R.C.; Meekins, J.F.; Fritz, G.; Shulman, S.D.; Friedman, H. Astrophys. J. Lett. 197: No. 1, L13-L17 (1 Apr 1975).

Data obtained in a 3-s observation of the Cygnus Loop (44–60 Å) indicate a 21.4 ms periodicity. When the pulsed fraction of 50–60 percent is removed, the residual intensity agrees well with the mean Loop intensity reported by others. The evidence therefore suggests that a compact object is present within the nebula. (auth)

9758 A SEARCH FOR STELLAR SOFT X—RAY SOURCES. Vanderhill, M.J.; Borken, R.J.; Bunner, A.N.; Burstein, P.H.; Kraushaar, W.L. (Space Physics Laboratory, Department of Physics, University of Wisconsin, Madison, WI 53706). Astrophys. J. Lett. 197: No. 1, L19-L22 (1 Apr 1975).

A sensitive soft X-ray survey of about one-tenth of the sky, carried out as part of the *Skylab* program and flown on 1973 July 28, revealed no evidence for soft X-ray emission from stellar sources. We present

upper limits to the soft X-ray luminosity of about 50 nearby stars. With nominal assumed values for stellar space densities, we show it unlikely that emission from giants, main sequence stars, white dwarfs, or stars in known binary systems can account for the soft X-ray diffuse background. (auth)

9759 THE SURFACE BRIGHTNESS OF THE NEBULOSITY IN BL LACERTAE. Kinman, T.D. (Kitt Peak National Observatory). Astrophys. J. Lett. 197: No. 2, L49-L51 (15 Apr 1975).

UBV observations of BL Lac through apertures with diameters in the range $7''-20''$ show a surface brightness distribution which is consistent with that expected for a giant elliptical galaxy with redshift 0.07 but not 0.02. The evidence from the change of color with aperture is inconclusive, probably because the assumption that the nonthermal component has a power-law distribution is only correct for the average of many observations. New photographs of the object are given. (auth)

9760 CENTAURUS X-3: NEW LOW- AND MEDIUM-ENERGY X-RAY OBSERVATIONS. Long, K.; Agrawal, P.C.; Garmire, G. (California Institute of Technology). Astrophys. J. Lett. 197: No. 2, L57-L59 (15 Apr 1975).

Low- and medium-energy X-ray observations of Cen X-3 during two pointed sounding rocket experiments are discussed. The lack of low-energy emission from Cen X-3 is consistent with the identification of Krzeminski's star as the optical counterpart of Cen X-3 and normal reddening, in contrast to an earlier measurement by Bleeker *et al.* (auth)

9761 *COPERNICUS:* THE X-RAY SPECTRUM OF CASSIOPEIA A. Charles, P.A.; Culhane, J.L.; Zarnecki, J.C. (Mullard Space Science Laboratory, Department of Physics and Astronomy, University College London); Fabian, A.C. Astrophys. J. Lett. 197: No. 2, L61-L63 (15 Apr 1975).

The MSSL X-ray telescopes on Copernicus have obtained the spectrum of the supernova remnant Cas A in the energy range 0.5-7.5 keV. The observations may be explained by a two-component thermal spectrum with temperatures of 8 and 30 million degrees K. This result can be broadly interpreted in terms of McKee's reverse shock wave model of young remnants where the lower temperature is attributed to the reverse shock and the higher one to the initial blast wave. A 3σ upper limit of 0.02 photons cm^{-2} s^{-1} was also derived for the emission from a line feature at 2 keV. (auth)

9762 HIGH-ENERGY X-RAY OBSERVATIONS OF A LUNAR OCCULTATION OF THE CRAB NEBULA. Ricker, G.R.; Scheepmaker, A.; Ryckman, S.G.; Ballintine, J.E.; Doty, J.P.; Downey, P.M.; Lewin, W.H.G. (Physics Department and Center for Space Research, Massachusetts Institute of Technology). Astrophys. J. Lett. 197: No. 2, L83-L87 (15 Apr 1975).

X-ray observations of both immersion and emersion for the lunar occultation of 1974 August 13, were conducted from a balloon-borne X-ray telescope. We find that ~70 percent of 20-150 keV (average photon energy ~50 keV) emission from Tau X-1 (3U 0531+21) originates in a region with dimensions $24' \pm 7'$ along position angle (P.A.) $=130°$, and $49' \pm 7'$ along P.A. $=244°$. The long direction of the high-energy X-ray source is approximately parallel to the direction of the magnetic field vector (projected onto the plane of the sky) derived from previously reported optical polarization measurements of this region. The centroid of the X-ray emitting region is offset $10' \pm 4'$ to the northwest of the pulsar NP 0532. (auth)

9763 DYNAMICS OF A SMALL BLACK HOLE IN A BACKGROUND UNIVERSE. D'Eath, P.D. (Department of Applied Mathematics and Theoretical Physics, Silver Street, Cambridge, England). Phys. Rev. D 11: No. 6, 1387-1403 (15 Mar 1975).

A technique involving matched asymptotic expansions is used to investigate the dynamics of a black hole surrounded by an external background universe, according to the Einstein field equations. The approximation scheme is valid provided that the background curvature is small compared to the curvature near the event horizon of the black hole. In this case the background produces only small perturbations of the basic Kerr geometry near the black hole, while the black hole only affects the background metric slightly at distances of the order of the background length scale. These two perturbation expansions are matched in some common region of validity. It is then shown that the black hole moves approximately along a timelike geodesic in the background, and that its spin is approximately parallelly transported along the geodesic. The largest effects of the black hole on the background and the largest distortions of the Kerr geometry caused by the background are analyzed in some detail. The background curvature induces distortions of a quadrupole nature in the black hole; these then slow down the rotation, so that the basic structure of the Kerr black hole changes over long time scales. A similar approach is used to describe the behavior of a small black hole in a background, under the Brans-Dicke field equations. In particular, it is shown that a black hole moves on a geodesic in the Einstein conformal frame; this confirms a conjecture by Hawking. (auth)

9764 OPTICAL VARIABILITY OF PKS0048-097. Usher, P. D.; Kolpanen, D. R.; Pollock, J. T. (Pennsylvania State Univ., University Park). Nature (London); 252: No. 5482, 365(29 Nov 1974).

The Parkes radio source 0048-097 has been identified with a neutral stellar object of 17 mag and, in common with the BL Lacertae class of QSOs it has a featureless optical spectrum. It is a rapid radio variable at high frequencies and has a radio spectrum similar to that of BL Lacertae. In this connection two further characteristics of the BL Lacertids were investigated — the rapidity of the optical variability, and the total range of optical variability and its correlation with the decimetric spectral index. (UK)

9765 MEASUREMENT OF CIRCULAR POLARISATION IN THE CRAB NEBULA AT 1,415 MHz. Weiler, K. W. (Rijksuniversiteit Graningen, Netherlands). Nature (London); 253: No. 5486, 24-25(3 Jan 1975).

Measurements of the distribution of circular polarization in the Crab Nebula at 1415 MHZ are reported, obtained during a series of high accuracy full polarization measurements using the Westerbork Synthesis Radio Telescope in November 1971. The resulting map is reproduced, and the results are discussed. The results are consistent with the amount of circular polarization expected from normal synchrotron radiation in a static magnetic field of 10^{-3} to 10^{-4} gauss. Whenever circular polarization was detected its sign is positive, and there is no indication of the sign reversals expected from a proposed toroidal structure (see Mon. Not. Royal Astron. Soc. 167:1(1974)). The simplest magnetic field structure consistent with the measurements is that of a relatively uniform field of 10^{-3} to 10^{-4} gauss with its line-of-sight component directed towards the observer, but an effective mechanism for maintaining such a field during the lifetime of the nebula is needed. (UK)

9766 INTERFEROMETRIC OBSERVATIONS OF THE STRUCTURE OF MAIN-LINE OH SOURCES. Harvey, P. J.; Booth, R. S.; Davies, R. D.; Whittet, D. C. B.; McLaughlin, W. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 3, 545-576(Dec 1974).

The OH maser sources W3 (OH), Sgr B2, W49 (positions 1 and 2), W75S, W75N, and VY CMa have been investigated at 1665 MHz with an interferometer of 23 km (132,000 wavelengths) baseline. The 1667 MHz emission from VY CMa was also studied. Relative positions of the brightest components of these sources have been measured to an accuracy of ~0.01″ arc. Maps of component positions have been obtained for all the sources; the overall sizes of the sources are typically a few seconds of arc. The size of the W3 (OH) source is very similar to that found for the associated H II region by Baldwin et al. (Nature; 241:38 (1973)). The 1665/7 MHz emission from VY CMa comes from a region which is much smaller than that of the 1612 MHz emission. It is argued that the interferometer measurements provide evidence for Zeeman splitting of the spectral features of W3 (OH) in a field of 4.7 mG. (auth)

9767 COPERNICUS: THE X-RAY STRUCTURE OF THE CRAB NEBULA. Hawkins, F. J.; Mason, K. O.; Sanford, P. W.; Culhane, J. L. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 41P-45P(Nov 1974).

The extent of the x-ray emitting region in the Crab Nebula is derived in two energy bands from observations by the Copernicus satellite. The measurements are compared with previous results and discussed in terms of a model for the nebular radiation. (auth)

9768 IS L COLUMBAE THE X-RAY SOURCE 3U 0545-32. Mason, K. O.; Charles, P. A. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 169: No. 3, 73P-75P(Dec 1974).

Extensive X-ray data on the OB runaway star μ Col, which lies near the centre of the error box for the source 3U 0545-32 (Giacconi et al. (Astrophys. J. Suppl.; No. 237:27:37(1974)) failed to reveal a significant signal from a region of sky 12 arcmin in diameter centred on the star. This result adds no support to the hypothesis that some runaway stars may be associated with collapsed companions. (auth)

9769 OBSERVATIONS OF 48 EXTRAGALACTIC RADIO SOURCES WITH THE CAMBRIDGE 5-km TELESCOPE AT 5GHz. Pooley, G. G.; Henbest, S. N. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 3, 477-526(Dec 1974).

The 5-km telescope at Cambridge has been used to map 48 extragalatic radio sources at 5 GHz with an angular resolution $2'' \times 2''$ cosec δ. The results are presented together with various physical parameters derived for the sources. (auth)

9770 SCO X-1 (V818 Sco) AS A BINARY SYSTEM. Lyutyi, V.M.; Syunyaev, R.A.; Shakura, N.I. (Shternberg Astronomical Institute, Moscow). Sov. Astron.—AJ 18: No. 5, 533-536 (Mar 1975).

Scropius X-1, the brightest x-ray source, is a member of a close binary system with a period of 3.9 days. This inference is drawn from an analysis of photometric and spectroscopic observations of the system. The distance of the system is greater than 2 kpc. The optical component is a late-type subgiant whose size is comparable to the critical Roche surface. The inclination angle of the system is 10–15°. As in the HZ (Her X-1) system, the optical variability results from x-ray heating of the hemisphere of the normal star facing the x-ray source. The continuum energy distribution of this "hot spot" corresponds to spectral type B0-O7, reddened by strong interstellar dust absorption. (auth)

9771 OH ABSORPTION IN THE SOURCE W22. Slysh, V.I. (Observatoire de Meudon). Sov. Astron.—AJ 18: No. 5, 537-538 (Mar 1975).

The OH absorption in the source W22 is produced by three individual clouds at radial velocities of 5.9, −4.5, and −11.0 km/sec. The two negative-velocity clouds have sizes comparable to the H II zones G353.1+0.6 and G353.2+0.9; they are located close to the zones, at the site of dark absorbing clouds. (auth)

9772 VARIATIONS IN PERIODS OF SOME PULSARS FROM OBSERVATIONS OF 1969–1973. Shabanova, T.V. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 5, 548-550 (Mar 1975).

A study of variations in the periods of pulsars PSR 0329, 0809, 0834, 0950, 1133, and 1919 over several years showed that no sudden changes exceeding 15 nsec were observed against the background of a linear increase in period. (auth)

9773 OBSERVATIONS OF THE FUNDAMENTAL ROTATION-VIBRATION BAND OF CN. Treffers, R.R. (Department of Astronomy, University of California, Berkeley). Astrophys. J. 196: No. 3, 883-886 (15 Mar 1975).

Three lines of the fundamental rotation-vibration band of CN have been observed in the laboratory using a King furnace. The transition moment squared has been found to be $R_e^2 = 7.5 \pm 3.1 \times 10^{-4}$ atomic units. In addition, the transition moment of the 0–0 band of the red system of CN has been measured to be $R_e^2 = 0.48 \pm 0.28$ atomic units ($f_{00} = 3.3 \times 1.9 \times 10^{-3}$). (auth)

9774 OBSERVATIONS OF SIX BINARY X—RAY SOURCES WITH THE UCSD OSO-7 X—RAY TELESCOPE. Ulmer, M.P. (University of California, San Diego). Astrophys. J. 196: No. 3, 827-835 (15 Mar 1975).

We report observations of six binary X-ray sources with the UCSD OSO-7 X-ray telescope: SMC X-1, Vel XR-1 (2U 0900-40), Cen X-3, Her X-1, Cyg X−1, and Cyg X-3. The results include: (1) a simultaneous X-ray and optical observation of SMC X-1; (2) a refined eclipse period for Vel XR-1, $P = 8^d.962 \pm 0^d.004$; (3) a factor of 2 decrease in the 7–11 keV flux during the non-eclipsed portion (phase 0.2–0.8) of the $2^d.08712$ cycle of Cen X-3 while the 11–18 keV flux remained essentially constant; (4) a 7–26 keV "turn-on" of Her X-1 with respect to the 35-day cycle which occurred by 1972 December 22.84 ± 0.06 and was ~ 0.5 days earlier than the 2–6 keV "turn-on" reported from Uhuru satellite observations; (5) a flattening in the shape of the Cyg X-3 spectrum between 1972 July ($dN/dE \propto 1/E^{2.07 \pm 0.13}$ photons $cm^{-2} s^{-1}$ keV^{-1}) and 1973 February ($dN/dE \propto [1/\exp(9.6 \pm 3.5\ keV/E)^{8/3}]\, 1/E^{2.7 \pm 0.4}$); (6) a summary of spectra for all the X-ray sources. (auth)

9775 OBSERVATIONS OF H 110α RADIO RECOMBINATION-LINE EMISSION ASSOCIATED WITH DISTRIBUTED IONIZED HYDROGEN. Jackson, P.D.; Kerr, F.J. (Astronomy Program, University of Maryland). Astrophys. J. 196: No. 3, 723-731 (15 Mar 1975).

Nine Milky Way positions have been observed for H 110α radio recombination-line emission associated with ionized hydrogen lying outside those large H II regions detectable as discrete sources on published radio continuum surveys. Line emission was detected for seven of the nine positions. The rapid change of profile shape with position, the lack of narrow-frequency-width profile components, and the correlation of line radiation with continuum radiation at the same positions lead to a conclusion that most of the line radiation originates in small H II regions along the line of sight, over at least the galactic longitude range $l = 24°$–$33°$. An electron temperature of $4400° \pm 600°K$ is associated with the line emission for this range. Other interpretations of the kind of regions emitting the line radiation are briefly discussed. (auth)

9776 Lyman-β AND FE II EMISSION FROM QSOs AND PECULIAR GALAXIES. Adams, T.F. (Yerkes Observatory, University of Chicago). Astrophys. J. 196: No. 3, 675-682 (15 Mar 1975).

The scattering of Lβ in an idealized QSO envelope is examined, including the effects of noncoherent scattering. Approximate analytic results are presented for plane-parallel and spherical geometries. Detailed numerical results for the plane-parallel case are also presented to show that the approximate treatment is reasonably accurate. It is shown that appreciable errors can be made if the observations of Lβ in QSOs are interpreted in terms of an analysis based on coherent scattering. Similar formulae are then derived for the scattering of multiplet 3UV of Fe II. The presence of optical Fe II emission (in this case, multiplet 42) is shown to indicate the presence of large amounts of matter in the region around the central nonthermal source. The effects of inhomogeneities in the scattering medium are considered briefly. (auth)

9777 HIGH-RESOLUTION RADIO OBSERVATIONS OF UNIDENTIFIED RADIO SOURCES FROM THE B2 CATALOG. Grueff, G.; Vigotti, M. (Univ., Bologna). Astron. Astrophys., Suppl. Ser.; 19: No. 2, 117-141(Feb 1975).

High-resolution radio observations of 199 sources selected from the B2 catalog are presented. Most of them are Empty Fields, that is, no optical object is visible at their position on the Palomar Sky Survey prints. Positions were obtained accurate to a second of arc, and structure information was obtained with a resolution of 6 arc sec. The observations were made with the Westerbork Synthesis Radiotelescope, operating at a frequency of 5 GHz. (5 figures, 3 tables) (auth)

9778 WESTERBORK SIX CENTIMETER OBSERVATIONS OF A COMPLETE SAMPLE OF QUASARS FROM THE B2 CATALOG. Fanti, C.; Fanti, R.; Ficarra, A.; Formiggini, L.; Giovannini, G.; Lari, C.; Padrielli, L. (Univ., Bologna). Astron. Astrophys., Suppl. Ser.; 19: No. 2, 143-187(Feb 1975).

A list of 116 QSS candidates from the B2 catalog is given in an area of 0.142 steradians, between 8^h and 16^h in right ascension and declination around 29°30′. The identifications are made on the basis of the excess in UV color, by using 48″ Schmidt multicolor plates taken at Palomar. The suggested identifications were observed at 6 cm at Westerbrok, and accurate radio positions, radio structure, and spectra are given for them. (auth)

Solar Phenomena

Refer also to abstracts 8734, 9728, 9934, 9948, 9959, and 10011.

9779 (AD-778090) STUDY OF THE RADIO FREQUENCY SPECTRUM OF THE SUN. Final Report, 1 March–30 September 1973. Maxwell, A. (Harvard Radio Astronomy Station, Fort Davis, Tex.(USA)). Jan 1974. Contract F19628-73-C-0231. 8p. (AFCRL-TR-74-0029). NTIS $3.00.

The report summarizes programs carried out under AFCRL Contract F19628-73-C-0231 with Harvard University. The contract was written to cover research work on the spectral characteristics of radio bursts from the Sun. The work was carried out at Fort Davis, Texas, with sweep-frequency receivers covering the band 10 to 4000 MHz. (auth)

9780 (AD-784427) SOLAR CYCLE VARIATION OF LARGE-SCALE CORONAL STRUCTURES. Antonucci, E.; Duvall, T. L. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). 26 Apr 1974. Contract N00014-67-A-0112-0068. 21p. (SU-IPR-569). NTIS $3.00.

A green line intensity variation is associated with the interplanetary and photospheric magnetic sector structure. This effect depends on the solar cycle and occurs with the same amplitude in the latitude range 60 degrees N–60 degrees S. Extended longitudinal coronal structures are suggested, which indicate the existence of closed magnetic field lines over the neutral line, separating adjacent regions of opposite polarities on the photospheric surface. (auth)

9781 (AD-784428) SOLAR ROTATING MAGNETIC DIPOLE. Antonucci, E. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). 26 Apr 1974. Contract N00014-67-A-0112-0068. 30p. (SU-IPR-570). NTIS $3.25.

A magnetic dipole rotating around an axis perpendicular to the rotation axis of the sun can account for the characteristics of the surface large-scale solar magnetic fields through the solar cycle. The polarity patterns of the interplanetary magnetic field, predictable from this model, agree with the observed interplanetary magnetic sector structure. (auth)

9782 (AD-785999) TECHNICAL DETAILS OF THE POLISH EXPERIMENT WITH THE GEOPHYSICAL ROCKET VERTIKAL-1 AND VERTIKAL-2. Hlond, M. Translated from Pomiary, Automat., Kontr.; 19: No. 5, 205-206(May 1973). 9p. (FTD-HC-23-2734-74). NTIS $3.25.

Certain technical details are discussed of the first Polish space experiment conducted from on board the soviet geophysical rockets Vertikal-1 and Vertikal-2. A block diagram is given of the scientific equipment for the investigation of the Sun's x-ray and ultraviolet radiation installed on the rocket. (GRA)

9783 (AD-787204) RELATIVE CORONAL ABUNDANCES DERIVED FROM X-RAY OBSERVATIONS. III. The Effect of Cascades on the Relative Intensity of Fe XVII Line Fluxes, and a Revised Iron Abundance. Walker, A. B. Jr.; Rugge, H. R.; Weiss, K. (Aerospace Corp., El Segundo, Calif. (USA)). 1 Oct 1974. 43p. (TR-0075(9260-02)-1; SAMSO-TR-74-218). NTIS $3.75.

Lines of Fe XVII are prominent in the coronal spectrum below 25 A. The intensities of the lines of the 2p−3d transitions near 15 A have been used in conjunction with coronal models, and the assumption that the excited states are populated only by collisional excitation from the ground state ("coronal excitation"), to determine the Fe abundance. Eight lines of Fe XVII were observed which originated from the (2P) 5 (3S), (2P) 5 (3D), and (2S) (2P) 6 (3D) configurations in the coronal spectrum between 13 and 18 A. Using a more complete theoretical model, and higher resolution observations which allow a number of line blends to be resolved, the authors have revised earlier calculation of the coronal abundance of Fe, and find an iron abundance relative to hydrogen of .000026, which is in excellent agreement with the photospheric iron abundance. (GRA)

9784 (COM-74-50087-358) IONOSPHERIC DATA. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Jun 1974. 120p. (NOAA-FA-358; NOAA-74072247). NTIS $1.00.

All the data available for June 1973 and any previous unpublished data for June from earlier years are included. Also published are detailed data for the same month from an exemplary station, Wallops Island (Washington) including daily-hourly values of all characteristics, F-plots for regular world days, and an N(H) contour graph. As timely information, there is included selected ionospheric data for a retrospective world interval. Also given is information on ionospheric data recently received at world data center A for solar-terrestrial physics and other information on availability of data from the WDC's. This issue contains tables and graphs of monthly median ionospheric data for June 1957 and each June to that of 1973. (GRA)

9785 (COM-74-50190-358-1) SOLAR-GEOPHYSICAL DATA NUMBER 358, JUNE 1974. Part I (Prompt Reports). Data for May 1974, April 1974. Leighton, H. I. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Jun 1974. 122p. (SGD-358-PT-1; NOAA-74072245). National Climatic Center, Asheville, NC 28801 $1.25.

Prompt reports are given on data for May 1974 and April 1974. These deal with alert periods, daily solar indices, solar flares, solar radio waves and spacecraft observations. This issue also includes an index for 1973 and 1974. (GRA)

9786 (COM-74-50190-358-2) SOLAR-GEOPHYSICAL DATA NUMBER 358, JUNE 1974. Part II (Comprehensive Reports). Data for December 1973, November 1973 and Miscellanea. Leighton, H. I. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Jun 1974. 49p. (SGD-358-PT-2; NOAA-74072246). National Climatic Center, Asheville, NC 28801 $1.25.

Comprehensive data for December 1973 and November 1973 on solar flares, solar radio waves, solar x-ray radiation, abbreviated calendar record, and regional flare index are provided. (GRA)

9787 (COM-74-50190-359-1) SOLAR-GEOPHYSICAL DATA NUMBER 359, JULY 1974. Part I (Prompt Reports). Data for June 1974, May 1974. Leighton, H. I. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Jul 1974. 123p. (SGD-359-PT-1; NOAA-74081306). National Climatic Center, Asheville, NC 28801 $1.25.

Data for June 1974 and May 1974 are given on alert periods, daily solar indices, solar flares, solar radio waves and spacecraft observations. This issue also includes an index for 1973 and 1974. (GRA)

9788 (COM-74-50190-359-2) SOLAR-GEOPHYSICAL DATA NUMBER 359, JULY 1974. Part II (Comprehensive Reports). Data for January 1974, December 1973 and Miscellanea. Leighton, H. I. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Jul 1974. 56p. (SGD-359-PT-2). National Climatic Center, Asheville, NC 28801 $1.25.

Comprehensive data for January 1974 and December 1973 on solar flares, solar radio waves, solar X-ray radiation, abbreviated calendar record, and regional flare index are given. (GRA)

9789 (JPRS-62677) OBSERVATIONS OF THE SUN OUTSIDE THE ATMOSPHERE. Krat, V. A. Translated from Priroda; No. 5, 35-41(1974). 16p. NTIS $3.00.

The report contains a description of observations of the sun using solar stratospheric observatories. (GRA)

9790 (N-74-30278) OBSERVATIONS OF LOW-ENERGY ELECTRONS UPSTREAM OF THE EARTH'S BOW SHOCK. Reasoner, D. L. (Rice Univ., Houston, Tex. (USA). Dept. of Space Physics and Astronomy). Aug 1974. 17p. (NASA-CR-138309). NTIS $4.00.

Observations of electron fluxes with a lunar-based electron spectrometer when the Moon was upstream of the Earth have shown that a subset of observed fluxes are strongly controlled by the interplanetary magnetic field direction. The fluxes occur only when the IMF lines connect back to the Earth's bow shock. Observed densities and temperatures were in the ranges 2 to 4 x 0.001/cu cm and 1.7 to 2.8 x 1,000,000 K. It is shown that these electrons can account for increases in effective solar wind electron temperatures on bow-shock connected field lines which have been observed previously by other investigators. It is further shown that if a model of the bow shock with an electrostatic potential barrier is assumed, the potential can be estimated to be 500 volts. (auth)

9791 INTERPLANETARY PROPAGATION OF STEADY SOLAR INJECTED PARTICLES. Cecchini, S. (CERN, Bologna); Martinic, N. J. Nuovo Cim.; 25B: No. 1, 191-207(11 Jan 1975).

The numerical solution of the spherically symmetric, steady-state Fokker-Planck equation of transport in a system of reference anchored at the Earth with the energy variable T, as measured in a frame moving with the solar wind, shows a good fit to recorded data in interplanetary space during 1965-1968. The boundary condition for a steady-state particle injection at the solar surface considers the energy transformation from the fixed frame into the moving one. Another possible introduction of boundary conditions via the differential current density is also discussed. Densities and gradients in an energy range (~6 orders of magnitude centred around 1 GeV/N) and radial distances (up to 5 AU) are illustrated in stereographic projections. In the computations the diffusion coefficient is given by $K_{rr} = K(r) \cdot K(P)$, and the density u reveals itself to be smooth, i.e., $\epsilon = (v/w) \left| \partial \ln u / \partial \ln T \right| \ll 1$, where w is the particle speed and v is the solar-wind velocity. The radial anisotropy is also presented. (auth)

9792 ENERGETIC SOLAR PARTICLES IN INTERPLANETARY SPACE. Amundsen, R. (Univ. of Bergen). Fra Fys. Verden; 36: No. 4, 88-96(1974). (In Norwegian).

The solar wind is a more or less constant stream of ionized gas emitted radially from the corona. It bears a magnetic field consisting of a nonfluctuating part which follows an Archimedes spiral, and a fluctuating part. This interplanetary magnetic field has a decisive influence on the motion of cosmic radiation in the interplanetary space, and has a sector structure, the field in each sector having a dominant direction, either out from or towards the Sun. Within each sector there is a fine, filament structure assumed related to the solar granulation. Solar flares lead to the formation of shock waves in the solar wind which causes the Forbush decrease in galactic cosmic radiation. Solar cosmic radiation, consisting mainly of protons, occurs spasmodically in connection with major flares, but can then, in the lower energy range, exceed galactic cosmic radiation by several orders of magnitude. Solar cosmic-ray events are usually divided into two classes, prompt events, occurring within hours of the initiating flare, and delayed events, occurring more than 24 hours after the initiating flare. Prompt events include all which increase the flux of particles of more than 100 MeV. Spectra show that the higher energy particles arrive first. Observable characteristics of prompt events are strongly dependent on the source flare's position on the Sun's surface. At an early stage in the event the particle flux is strongly anisotropic, with the maximum flux along the magnetic field line, later the degree of anisotropy decreases and the direction becomes parallel to the solar wind, still later to 45°E of the Sun. (NO)

9793 GROWTH AND DECAY OF SUNSPOTS. Meyer, F.; Schmidt, H. U.; Weiss, N. O.; Wilson, P. R. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 35-57(Oct 1974).

The evolution of a sunspot is related to supergranular convection. Magnetic flux is concentrated by converging supergranular flow to form the sunspot. Equilibrium requires a magnetic field strong enough to inhibit convection in the photosphere but small scale convection is still possible at depths greater than 2000 km below the spot. The region surrounding this flux rope is imperfectly cooled. As a result the direction of flow in adjacent supergranules may be reversed. If the flux rope is inclined or split it may be broken up and the spot will decay rapidly; if it is predominantly vertical the reversed flow forms an annular cell (corresponding to the moat) about the spot, which is preserved through a phase of slow decay. The strong field prevents large scale convection in this cell from penetrating

into the flux rope beneath the spot but small flux tubes diffuse outwards at a rate which is determined by the modified small scale convection. They are then torn away from the penumbra and carried across the moat, appearing as moving magnetic features in the photosphere. A simple model of this decay process explains the observed linear decay of flux with time and is supported by some numerical experiments. (auth)

9794 DIFFERENCES BETWEEN THE BULK SPEEDS OF HYDROGEN AND HELIUM IN THE SOLAR WIND. Ogilvie, K.W. (Laboratory for Extraterrestrial Physics, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 80: No. 10, 1335-1338 (1 Apr 1975).

This note describes observations made by the Goddard Space Flight Center plasma instruments on Explorer 43 of differences between the bulk speeds of helium and hydrogen. Arguments are given for regarding these differences as a characteristic of the interplanetary medium on the macroscale associated with the whole region of a stream-stream interaction. If the differences were caused by the action of Alfvén waves, then on these occasions they must have been produced closer to the sun than to 1 AU. (auth)

9795 A SEARCH FOR SOLAR WIND VELOCITY CHANGES BETWEEN 0.7 AND 1 AU. Intriligator, D.S. (Physics Department, University of Southern California, Los Angeles, California 90007); Neugebauer, M. J. Geophys. Res. 80: No. 10, 1332-1334 (1 Apr 1975).

Simultaneous observations of the solar wind velocity as measured at the Pioneer 9 and Ogo 5 spacecraft during five solar rotations in 1968 and 1969 are presented. During this time, Pioneer 9 was traveling in toward the sun to approximately 0.7 AU while the earth orbiter Ogo 5 was spending long periods in the interplanetary medium. A comparison of the 3-hour averages of solar wind velocity obtained at both spacecraft indicates that the same basic solar wind velocity structure was seen at both spacecraft. There was no statistically significant dependence of average velocity on radial distance from the sun. The amplitude of variations about the average velocity apparently decreased with increasing distance from the sun; some but probably not all of this decreased variation is consistent with the exchange of momentum between high-velocity and low-velocity streams. The correlation coefficient of pairs of velocity averages computed from a corotation model decreases with increasing distance between the two spacecraft. (auth)

9796 IMPLICATIONS OF OBSERVED CHARGE STATES OF LOW-ENERGY SOLAR COSMIC RAYS. Jokipii, J.R. (Department of Planetary Sciences, University of Arizona, Tucson, Arizona 85721); Owens, A.J. J. Geophys. Res. 80: No. 10, 1209-1212 (1 Apr 1975).

Recent measurements of the charge states of low-energy (~100 keV/nucleon) solar cosmic rays at 1 AU are discussed. The measurements are consistent with models involving charge equilibrium with neutral matter at the sun only if the particles lose ~90% of their energy owing to adiabatic deceleration in the solar wind. Such an energy loss is shown to be possible only if the diffusion coefficient for 1-MeV/nucleon particles is smaller than 10^{20} cm^2 s^{-1}. The implications of these results for models of solar cosmic ray acceleration are discussed. (auth)

9797 NONLINEAR OBLIQUE INTERACTION OF INTERPLANETARY TANGENTIAL DISCONTINUITIES WITH MAGNETOGASDYNAMIC SHOCKS. Neubauer, F.M. (Institut für Geophysik und Meteorologie, Technische Universität Braunschweig, Braunschweig, Germany). J. Geophys. Res. 80: No. 10, 1213-1222 (1 Apr 1975).

The nonlinear oblique interaction between a plane tangential discontinuity (TD) and a plane fast magnetogasdynamic shock is treated generally and then applied to the interplanetary TD-bow shock interaction. A number of similarity relations are found for the general problem. For the frequent directional TD's the interaction is strongest if the directional change is 90° and one of the magnetic field vectors is parallel to the shock. Bow shock motions of up to several tens of kilometers per second are induced by these TD's. Tangential discontinuities with density jumps held responsible for geomagnetic sudden impulses lead to a much stronger interaction with the bow shock with nonnegligible strength of the newly generated wave. The oblique interaction requires weaker TD's to produce observed bow shock velocities. It is also shown that complex nonlinear wave patterns very often develop, which have not been predicted in the past in this context. (auth)

9798 NUMERICAL MHD SIMULATION OF INTERPLANETARY SHOCK PAIRS. Steinolfson, R.S.; Dryer, M. (Space Environment Laboratory, NOAA, Boulder, Colorado 80302); Nakagawa, Y. J. Geophys. Res. 80: No. 10, 1223-1231 (1 Apr 1975).

Solar wind disturbances produced by relatively long-lasting solar flares are simulated numerically by using the single-fluid magnetohydrodynamic (MHD) equations with negligible dissipation. The computations are confined to the ecliptic plane of a spherically symmetric flow and are begun when an initial disturbance is introduced near the sun in the ambient solar wind. The velocity and density in the disturbances do not differ appreciably from the values obtained by using an ordinary fluid dynamic calculation, but the thermal pressure exhibits a marked decrease near the contact (or 'piston') discontinuity. A comparison with several MHD similarity solutions shows the advantages of the present analysis over the latter theory to be the following: (1) it yields a quantitative prediction of the azimuthally induced plasma flow, (2) it provides for removal of the nonphysical zero pressure at the contact surface, and (3) it allows more flexibility in the specification of initial conditions, which gives the present analysis greater utility in predicting plasma and magnetic data. Alternative initial disturbances, such as pulses in radial velocity or thermal pressure, produce multiple nonlinear variations of the density, thermal pressure, and magnetic field. Spatial and temporal variations of the thermal and magnetic energy densities are thereby indicated. (auth)

9799 SOLAR NEUTRINOS AND ROTATION: A CAUTION. Monaghan, J. J. (Monash Univ., Clayton, Australia). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 13P-14P(Oct 1974).

The use of a spherically averaged rotation force is shown to lead to a gross underestimate of the minimum neutrino flux from differentially rotating solar models. (auth)

9800 SHORT-WAVE SOLAR RADIATION SPECTRUM AT DIFFERENT ACTIVITY LEVELS. Ivanov-Kholodnii, G. S.; Firsov, V. V. Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 331-334(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 393-398(1974).

The short-wave ionizing solar radiation spectrum ($4 < \lambda < 1037$ Å) is constructed by a semi-empirical method on the basis of available experimental data for four solar activity levels corresponding to the index $F_{10.7} = 100$, 120, 144, and 200. A table of radiation intensities for 150 spectral intervals is presented. Spectral variations with solar activity are examined. (auth)

9801 THE SIZE DEPENDENCE OF SUBLIMATION RATES FOR INTERPLANETARY ICE PARTICLES. Patashnick, H. (Dudley Observatory, Albany, New York); Rupprecht, G. Astrophys. J. Lett. 197: No. 2, L79-L82 (15 Apr 1975).

The sublimation rates for water ice have been computed as a function of particle size for various solar distances. Because of the size dependence of the absorption and emission properties of the particles, a sublimation rate minimum evolves whose depth and position is sensitive to the spectral absorption properties of the particle in combination with the spectral distribution of solar radiation. As a consequence, a quasi-stable size of interplanetary ice particles is predicted which is independent of solar distance. (auth)

9802 FE XXIII 263 Å AND FE XXIV 255 Å EMISSION IN SOLAR FLARES. Widing, K.G. (E. O. Hulburt Center for Space Research, Naval Research Laboratory). Astrophys. J. Lett. 197: No. 1, L33-L35 (1 Apr 1975).

A line observed at 263.7 Å in ATM/NRL solar flare spectra is identified as Fe XXIII $2s^2\ ^1S_0$-$2s2p\ ^3P_1$. The identification is confirmed by observation of the intercombination line along the isoelectronic sequence, including S XIII, Ar XV, Ca XVII, Cr XXI. The predicted intensity of Fe XXIII 263 Å relative to Fe XXIV 255 Å is in qualitative agreement with the observed. Significant characteristics of the Fe XXIII and Fe XXIV images observed in the flare of 1973 June 15 are (1) an archlike spatial structure spanning the magnetic neutral line and (2) a Doppler-widened emission core, which may pinpoint the site of the energy release. (auth)

9803 PLASMA STUDY IN THE EARTH'S MAGNETOSPHERE AND IN INTERPLANETARY SPACE BY SATELLITES OF THE PROGNOZ SERIES. Bezrukikh, V. V.; Belyashin, A. P.; Volkov, G. I. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 335-341(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 399-406(1974).

The equipment and method used in the plasma experiment on the Prognoz, Prognoz-2, and Prognoz-3 satellites are described. Samples of the data obtained and the average daily values of solar-wind ion fluxes are presented for April-August 1972. (auth)

9804 PISTON SHOCK WAVES IN THE INTERPLANETARY MEDIUM AND FORBUSH EFFECTS. Krymskii, G. F.; Transkii, I. A.; Elshin, E. K. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 342-345(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 407-410(1974).

Cosmic-ray modulation produced by the propagation of piston shock waves in the interplanetary medium is investigated. It is demonstrated that, in the case of a nonspherical wave, regions of enhanced cosmic-ray concentration appear in the vicinity of both shock fronts. From a comparison with observations it follows that the shock fronts have a complex structure. Computations for a spherically symmetric case are presented. (auth)

9805 INTERPLANETARY MAGNETIC FIELD AND SEISMIC ACTIVITY. Kalinin, Yu. D. (Inst. of Physics, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 422-424(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 502-505(1974).

From the data on earthquakes in 1897–1956 and 1963–1968 it is concluded that regions of enhanced seismic activity appear successively within the 11-year solar cycle at geographic latitudes at an ever increasing distance from the North Pole. An explanation of this pattern is proposed. (auth)

9806 SOLAR MODELS WITH ROTATING CORES AND AUTHOR'S REPLY. Rood, R. T. (Univ. of Virginia, Charlottesville); Ulrich, R. K.; Demarque, P.; Mengel, J. G.; Sweigart, A. V. Nature (London); 252: No. 5482, 366-368(29 Nov 1974).

Reference is made to Demarque and others (Astrophys. J. 183:997(1973); Nature Phys. Sci. 246:33(1973)) who suggested that it is possible to employ solar models with rapidly rotating cores to explain low solar neutrino fluxes. Certain difficulties are, however, pointed out in the present communication. The rotation must be so rapid that is approximate treatment by the foregoing authors is of doubtful validity, and difficulties also arise in connection with solar oblateness. Additional problems with rotating solar models have also been discovered and are discussed. It is concluded that the models proposed seem to be ruled out as solutions to the solar neutrino problem. A reply by Demarque and others is appended. (UK)

9807 SOLAR WIND EXPANSION WITH A HEAT-LOSS FUNCTION. Khanna, S.; Talwar, S. P. (Univ. of Delhi). Planet. Space Sci.; 22: No. 12, 1637-1640(Dec 1974).

The problem of steady expansion of the solar wind is investigated allowing for heating and cooling mechanism in the medium. Single fluid equations are employed, neglecting viscosity and magnetic fields. It is found that the flow characteristics are modified in the regions near the Sun though the location of the critical point and the flow speeds beyond it are unaffected. It is surmised that the solar wind must originate at higher levels if it is subject to a heat-loss due to bremsstrahlung. (auth)

9808 CONCERNING THE COMPATIBILITY OF AN ARCHIMEDES' SPIRAL INTERPLANETARY MAGNETIC FIELD WITH THE PRESENCE OF INTERSTELLAR NEUTRAL HYDROGEN IN THE SOLAR CAVITY. Webb, S. (Imperial Coll. of Science and Tech., London). Planet. Space Sci.; 22: No. 12, 1719-1723(Dec 1974).

A self-consistent computation of the interplanetary magnetic field is presented which takes into account the effects of interstellar particles newly ionised on entering the solar cavity. The resulting field differs infinitesimally from the Parker spiral for all reasonable parameters and is in agreement with recent observations on board Pioneer 10. (auth)

9809 CORRELATION OF THE AIR TEMPERATURE AT CATANIA AND THE SUNSPOT CYCLE. Blanco, C.; Catalano, S. (Citta Univ., Catania, Italy). J. Atmos. Terrest. Phys.; 37: No. 1, 185-187(Jan 1975).

Results of the correlation between the air temperature recorded at Catania in the period 1817 to 1970 and the sunspot number R, are reported. The temperature and the sunspot number, both averaged over the 11 year solar cycle, give a coefficient $r = 0.5$ for a linear correlation. The higher mean temperatures are associated with the more active solar cycles and the lower mean temperatures with cycles of lower mean activity. No reliable correlations were found in time scales of less than a solar cycle. (auth)

9810 CORONAL ELECTRON DENSITY AND TYPE III BURST THEORY. Boischot, A. (Observatoire de Paris, Section de Meudon, 92 (France)). Astron. Astrophys.; 33: No. 3, 379-380 (Jul 1974).

The density in the corona derived from the study of type III burst source positions is shown to be of the same order of magnitude, whether it is assumed that the emission is at the fundamental or at the harmonic of the plasma frequency. On the other hand, this density depends very much upon the assumed characteristics of the propagation of the waves in the corona. (orig.)

9811 FURTHER EVIDENCE FOR THE POLARIZED RADIATION FROM THE SUN IN THE FAR INFRARED. Dall'Oglio, G.; Fonti, S.; Guidi, I.; Melchiorri, B.; Melchiorri, F.; Natale, V.; Lombardini, P.; Trivero, P. (Consiglio Nazional delle Ricerche, Florence). Infrared Phys.; 14: No. 4, 327-333(Nov 1974).

The polarization of the Sun's radiation has been measured in the 30 to 10 cm^{-1} spectral region through the atmospheric windows at the high altitude observatory of Testa Grigia, Italy, at 3500 m a.s.l. The results are in agreement with those previously obtained during a balloon flight in the 100 to 5 cm^{-1} region. The spectral dependence of the linearly polarized component has been investigated and a possible interpretation of the obtained data is suggested. (auth)

9812 MEASUREMENT OF SOLAR TEMPERATURE IN THE FAR INFRARED. Dall'Oglio, G.; Fonti, S.; Guidi, I.; Melchiorri, B.; Melchiorri, F.; Natale, V.; Lombardini, P.; Trivero, P. (Consiglio Nazional delle Ricerche, Florence). Infrared Phys.; 14: No. 4, 323-325(Nov 1974).

The temperature of the Sun in the 300 to 1000 μm region has been measured through the atmospheric windows at the high altitude observatory of Testa Grigia, Italy, 3500 m a.s.l. The far i.r. detector used in this experiment is a 150 cm flux collector with a germanium bolometer. With a set of interferential filters coupled to a specially designed radiometer it was possible to isolate and measure the atmospheric windows transmittance with a precision of 1%. The results obtained are in agreement with the HSRA model of the Sun. (auth)

9813 STABILITY OF A SOLAR MODEL TO NON-RADIAL OSCILLATION. Christensen-Dalsgaard, J.; Dilke, F. W. W.; Gough, D. O. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 3, 429-445(Dec 1974).

The stability of a solar model to low-order gravity modes has been investigated in quasiadiabatic approximation, neglecting any direct effects of convection on the oscillations. The zero age main sequence model was found to be stable, but after about 2×10^8 yr the g1 ($l = 1$) mode became unstable. The dominant destabilization comes from the dependence of the pp chain reaction rate on the abundances of ^{3}He and H when nuclear equilibrium is disturbed, and is felt once a sufficient ^{3}He inhomogeneity is established in the energy generating core. (auth)

9814 SOLAR ACTIVITY AND THE WEATHER. Wilcox, J. M. (Stanford Univ., CA). J. Atmos. Terrest. Phys.; 37: No. 2, 237-256(Feb 1975).

The attempts during the past century to establish a connection between solar activity and the weather are discussed. Some critical remarks about the quality of much of the literature in this field are given. Several recent investigations are summarized. Use of the solar-interplanetary magnetic sector structure in future investigations may add an element of cohesiveness and interaction to these investigations. (auth)

9815 ^{26}Al IN CORES OF THE KEYES CHONDRITE. Cressy, P.J. (Earth Resources Branch, Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 80: No. 11, 1551-1554 (10 Apr 1975).

Cosmogenic ^{26}Al was measured in six samples from two cores of the Keyes chondrite, previously analyzed for spallogenic ^{3}He, ^{21}Ne, and ^{38}Ar. Specific activities varied from 68.9±5.4 dpm/kg near the center (depth, ~30 cm) to 50.9±3.7 near the postatmospheric surface (depth, ~3 cm). The data are consistent with an approximately linear decrease in ^{26}Al activity with radial distance r from the center of Keyes: $(^{26}Al)_{obs}/(^{26}Al)_{calc} = 1.04\ (\pm 0.05) - 0.0104(\pm 0.0032)(r)$. The measured ^{26}Al (dpm/kg)/^{21}Ne (10^{-8} cm^3/g) ratio is constant at 6.13±0.18 for the six samples, corresponding to an average atomic production ratio of 0.222 for the meteorite. (auth)

9816 XENON ISOTOPE ANOMALIES IN THE CARBONACEOUS CHONDRITE MURCHISON. Kuroda, P.K.; Sherrill, R.D.; Efurd, D.W.; Beck, J.N. (Department of Chemistry, University of Arkansas, Fayetteville, Arkansas 72701). J. Geophys. Res. 80: No. 11, 1558-1570 (10 Apr 1975).

The isotopic compositions have been measured mass spectrometrically for xenon fractions released from the carbonaceous chondrite Murchison in stepwise heating experiments. Variation of the isotopic ratios was found to be relatively small: for example, the ^{136}Xe/^{132}Xe ratio in the 600°C fraction was 0.328 (the atmospheric ratio is 0.330), and the ratio in the 1500°C fraction was 0.310 (the Sucor ratio is 0.301), whereas the ratios observed in other temperature fractions had intermediate values. It appears that these variations can best be explained as being due to the fact that reservoirs of two isotopically distinct gases (solar and planetary) exist in the meteorite and that mixtures of these gases in various proportions are being released at different temperatures. The major difference in the isotopic compositions of solar and planetary xenon can be atributed to a mass-dependent fractionation process, but the solar xenon contains excesses of xenon isotopes at mass numbers 128, 130, 131, and 132 that appear to have been produced by neutron capture processes that took place in the sun during its deuterium-burning stage. The solar xenon must have been transported from the sun to the meteorites in the form of solar wind. The relative abundances of the light isotopes of xenon in carbonaceous chondrites are appreciably altered by the cosmic ray irradiation process. The decay products of ^{129}I and ^{244}Pu further modify the isotopic compositions of xenon fractions released from the carbonaceous chondritis. According to this interpretation, it is unnecessary to assume the existence of the so-called Renazzo-type fission xenon component (CCF or xenon X) in the carbonaceous chondrites. (auth)

9817 INFLUENCE OF SOLAR CURVATURE OF LIGHT RAYS ON CLOCK CORRECTIONS AND LATITUDE DETERMINATIONS. Brandt, V.É. (Shternberg Astronomical Institute, Moscow). Sov. Astron.—AJ 18: No. 5, 649-653 (Mar 1975).

The shift of star images caused by the sun's gravitational field is considered in general form, and the influence of the shift on equatorial star coordinates, latitude determinations, and clock corrections is established. Numerical values are given for the effect of light curvature on the latitude and clock correction for zenith stars observed at 50° latitude. In certain cases the effect must be taken into account. (auth)

9818 POLARIZATION OF FLARE X RAYS WITHOUT BEAM ANISOTROPY. Beigman, I.L. (Lebedev Physics Institute, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 5, 600-601 (Mar 1975).

The polarization of hard x rays from solar flares due to Thomson scattering in the photosphere is discussed. For the scattered radiation the percentage polarization ranges from +20% to −80% (positive if the electric vector of preferential polarization is directed toward the center of the solar disk), depending on the height of the flare and its angular distance from the center. For the total radiation the polarization ranges from +1.7% to −2%. It should be possible to observe polarization of the x rays from cosmic sources comprising binary systems. Polarimetric observations of scattered x-ray lines would be of special interest. (auth)

9819 CONTRAST OF SOLAR PLAGES AND MODEL FOR AN ACTIVE REGION. Kononovich, É.V.; Nikulin, I.F. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 18: No. 5, 602-605 (Mar 1975).

The contrast of active regions on spectroheliograms obtained in various lines is used to obtain information on the temperature and density variations in moderately active regions at various levels in the solar atmosphere which coincide with flares and plages. In the lower chromosphere the brightening at a plage is due to a density increase by a factor of about 1.5 and a temperature increase by 3000 °K. There is a tendency for the density to remain constant over height in the transition layer and in the corona, causing the relative density to increase with height (in comparison with that of the unperturbed atmosphere at the same height). This mechanism explains the observed contrast on spectroheliograms obtained in far-UV lines. A method has been worked out for determining Δn_e and ΔT_e on the basis of the observed contrast; a model is proposed for an active region. (auth)

9820 SOURCE FUNCTION FOR A SOLAR FLARE. Kozhevnikov, N.I.; Roshchina, E.M. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 18: No. 5, 606-608 (Mar 1975).

A method for calculating the source function for a solar flare is outlined. The integral equation for the source function is solved by a method based on the concept of an inverse operator. It is concluded that there are actually hot and cold zones in a flare. (auth)

9821 DEPENDENCE OF THE FORMATION DEPTH OF THE WEAK FRAUNHOFER LINES ON ATOMIC PARAMETERS. Gurtovenko, É.A.; Ratnikova, V.A. (Main Astronomical Observatory, Academy of Sciences of the Ukrainian SSR). Sov. Astron.—AJ 18: No. 5, 609-611 (Mar 1975).

A correct calculation of the mean optical depths of formation of the weak Fraunhofer lines reveals a clear dependence of these depths on the excitation potential of the lower levels involved in the corresponding transitions. In addition, the mean optical depths depend on the ionization potentials χ_0, χ_1 and the partition functions U_0, U_1, U_2. The combined effect of these latter parameters can differ for the lines of different atoms and ions. The mean optical depths are plotted as a function of the ionization potential of the lower level of the line for certain atoms and ions. (auth)

9822 QUIET-SUN EQUATORIAL BRIGHTNESS DISTRIBUTION AT A WAVELENGTH OF 4.08 MM. Kislyakov, A.G.; Kuznetsov, I.V.; Kuznetsova, N.A.; Chernyshev, V.I.; Serov, N.V. (Gor'kii Radiophysical Institute). Sov. Astron.—AJ 18: No. 5, 612-616 (Mar 1975).

A study of the equatorial brightness distribution of the quiet sun at a wavelength of 4.08 mm with the RT-25×2 passage radiotelescope of the Scientific-Research Institute of Radiophysics is reported. There are systematic deviations of the actual brightness distribution from a flat distribution. Brightness distributions over the solar disk for $\lambda = 4$ mm are calculated for certain chromospheric models, and the results are compared with experiment. (auth)

9823 PHYSICAL CONDITIONS IN THE CORONAL MAGNETIC TUBES. Lyong, L.V. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 18: No. 5, 617-620 (Mar 1975).

Steady-state streams sufficient to form the quiescent prominences of Pikel'ner's siphon theory can flow in coronal magnetic tubes. The distributions of the temperature, particle density, and velocity along a tube are obtained for a steady-state stream. A slight necking of the tube is sufficient to cause condensation of the stream. The temperature and particle-density distributions along the tube are found for the static case. The temperature in the tube is slightly lower, and the density is slightly higher, than in the surrounding corona. The density and temperature distributions are governed primarily by the energy flux: At low fluxes the temperature drops only very slightly with height, while the density drops significantly; at high fluxes both the temperature and density drop. The conductive flux is proportional to the square of the pressure. A simple method is described for determining the physical properties of the tube in the static case. (auth)

9824 GASDYNAMICS OF A FLARE REGION HEATED BY A STREAM OF HIGH-VELOCITY ELECTRONS. Kostyuk, N.D.; Pikel'ner, S.B. (Shternberg Astronomical Institute, Moscow). Sov. Astron.—AJ 18: No. 5, 590-599 (Mar 1975).

Electrons with an E^{-3} energy spectrum (for $E \geq 10$ keV) are considered to descend from the corona into the chromosphere during a 100 sec period. Distribution of the temperature, density, ionization, and velocity of the gas are calculated for flux densities $F = (0.4, 1.0, 4.0) \cdot 10^{10}$ ergs-cm^{-2}-sec^{-1} in both the heating phase and the cooling phase (after the outburst). A temperature jump resulting mainly from heat conduction is propagated through the gas. A shock wave is propagated ahead of the temperature jump, heating and compressing the gas. Viscosity is neglected, and heating by the shock wave does not appear explicitly, although it is estimated from the Hugeniot adiabatic curve. The velocity is found to decrease with depth. After a certain interval following passage of the shock the velocity changes sign; the descent is replaced by an ascent and oscillations subsequently develop. During the cooling phase the temperature of the hot region first decreases, accompanied by a drop in the temperature of the cool region. The temperature jump shifts upward at this stage, but very gradually at the outset. The cooling gas then becomes denser and begins to sink downward. The present calculations explain the principal features observed during the active phase of flares. Enhancement of Hα emission results both from heating of the gas by penetrating particles and thermal conduction and from the action of the shock wave. Gas motions in the shock region should be taken into account when deriving Hα line profiles. (auth)

9825 LOW-FREQUENCY FLUCTUATIONS IN THE SOLAR WIND. I. THEORY. Wu, C.S. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland); Huba, J.D. Astrophys. J. 196: No. 3, 849-857 (15 Mar 1975).

Several simple relationships between the power spectra of density and velocity fluctuations and the power spectrum of magnetic field fluctuations are derived within the context of plasma kinetic theory. The theory is restricted to the low-frequency regime (less than the proton cyclotron frequency) where hydromagnetic turbulence is expected to play the most important role. The affects of Alfvén and magnetosonic waves upon the plasma fluctuations are discussed separately. The results are then applied to proton fluctuations in the solar wind, demonstrating a connection between plasma and field fluctuations. (auth)

9826 DYNAMICS OF THE SOLAR MAGNETIC FIELD. V. VELOCITIES ASSOCIATED WITH CHANGING MAGNETIC FIELDS. Levine, R.H.; Nakagawa, Y. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado). Astrophys. J. 196: No. 3, 859-866 (15 Mar 1975).

Methods of determining horizontal velocities from the magnetic induction equation on the basis of a time series of magnetogram observations are discussed. For the flare of 1972 August 7, it is shown that a previously developed method of predicting positions of likely flare activity provides reasonable agreement with observations. Limitations to this type of solution of the magnetic induction equation are pointed out, and unambiguous solutions, corresponding to phenomenological determinations of velocity patterns under various physical circumstances, are presented for simple magnetic configurations. Implications for the analysis of changes in a series of magnetogram observations are discussed. (auth)

9827 INTERPLANETARY GAS. XX. DOES THE RADIAL SOLAR WIND SPEED INCREASE WITH LATITUDE? Brandt, J.C. (Laboratory for Solar Physics and Astrophysics, NASA-Goddard Space Flight Center, Greenbelt, Maryland); Harrington, R.S.; Roosen, R.G. Astrophys. J. 196: No. 3, 877-878 (15 Mar 1975).

The astrometric technique used to derive solar wind speeds from ionic comet-tail orientations has been used to test the suggestion that the radial solar wind speed is higher near the solar poles than near the equator. We find no evidence for the suggested latitude variation. (auth)

9828 DIRECT OBSERVATIONS OF HIGHER FREQUENCY DENSITY FLUCTUATIONS IN THE INTERPLANETARY PLASMA. Intriligator, D.S. (Physics Department, University of Southern California). Astrophys. J. 196: No. 3, 879-882 (15 Mar 1975).

Direct observations from the Ames Research Center plasma spectrometers on Pioneer 6 at 1 a.u. in 1965 December have been used

to obtain the power associated with fluctuations in the number density of solar-wind protons in the 10^{-3} to 10^{-2} Hz frequency range. A power-law spectrum of $f^{-1.2\pm0.1}$ is obtained in this frequency range. The extension of the power-law density spectrum based on direct observations to these higher frequencies is consistent with previous extrapolations of both spacecraft and interplanetary scintillation observations and with the dominance of large-scale turbulence in the solar wind. This result is also consistent with direct observations of the solar-wind proton speed and the interplanetary magnetic field. (auth)

9829 RADIATION OF CHROMOSPHERIC FLARES IN HYDROGEN LINES. Kurochka, L. N.; Kurochka, E. V.; Ostapenko, V. A. (Kiev State Univ.). Bull. Astron. Inst. Czech.; 26: No. 1, 23-29(1975).

The radiation energy of flares of various importances was computed in the Lyman, Balmer, Paschen, and Brackett series of hydrogen for different values of the optical thicknesses of the flares. It is shown that the amount of energy reduced in all emission lines of H is 4 to 5 times larger than the amount radiated by flares in H-alpha. The statistical processing of the observational data yielded the area S, the relative intensities of H-alpha $I_{3,2}/I_{\lambda}^{\odot}$, the derived Doppler width $\Delta\lambda_D/\lambda$ at the time of the maximum, the duration of the flares T and the relative number of flares of various importances, Λ, occurring on the Sun, characteristic for these flares. After the character of the time variation of the fundamental flare parameters was determined, the total energy of the radiation of flares of various importances was estimated; this energy varies in order of magnitude proportionally to units of flare importance. The total energies, radiated by the flares of each importance, are roughly the same. (auth)

9830 RIGIDLY ROTATING COMPONENT OF THE SOLAR CORONA. Antonucci, E. (Univ., Turin). Nuovo Cim.; 25B: No. 2, 513-520(11 Feb 1975).

Analyses of the green-line intensity (Fe XIV) for 1947–1970 suggest that the corona is organized on a very large scale. Long-lived structures do exist with the following characteristics: rigid rotation up to ±60° in latitude, correlation with the large-scale solar magnetic pattern. They develop essentially as longitudinal persistent features, close to the boundaries of the solar magnetic sectors. (5 figures) (auth)

9831 ON THE RELATIVE LOCATION OF NOISE-STORM EMISSION REGIONS. Yurovskaya, L. I. Izv. Krym. Astrofiz. Observ.; 47: 79-82(1973). (In Russian).

From the results of observations of three solar eclipses at a wavelength of 1.37 m a determination was made of the general features of the structures of noise-storm sources. It is shown that in these cases the region of the radiation bursts was large-sized, and was located closer to the eastern edge of the solar disk than the region of increased background radiation. A good correspondence is noted between the magnetic flux of the main part of the group of sunspots and the flux density of the background radiation of the noise storm, and also between the flare intensity and the magnetic flux of the tail part in one of the cases which were looked at. (SJR)

9832 ON THE FORECASTING OF THE SOLAR RADIO BURSTS. Yurovskij, Yu. F.; Gerasimov, V. P. Izv. Krym. Astrofiz. Observ.; 47: 71-78(1973). (In Russian).

With the purpose of determining the extent of the connection of the integral flux density of solar radio emissions with solar flare activity a statistical analysis was carried out of data on the character of the solar radio emission at a frequency of 2800 Mhertz over 500 days of observations (Jan 1967 to Sept 1968). From statistical correlations which were obtained it was possible to predict from a known magnitude of flux density the number of radio bursts with a probable deviation of about 30%. A study was made of the flare intensity distribution as a function of flux density. It is shown that for reliable forecasting of proton events, information only on the flux of solar radio emission at a fixed wave length in the centimeter range is insufficient. (SJR)

9833 ON THE PROPERTIES OF A LARGE-SCALE VELOCITY FIELD IN THE QUIET SOLAR ATMOSPHERE. Gopasyuk, S. I.; Tsap, T. T. Izv. Krym. Astrofiz. Observ.; 47: 26-35(1973). (In Russian).

A study was made of a large scale velocity field in an unperturbed solar atmosphere. Measurements of radiant velocities and magnetic fields in the center of the solar disks and at the poles were carried out on a double magnetograph from the lines H_{α}, K_3 Ca II, H_{β}, H_{γ}, H_{δ}, λ 5184 Å Mg I, λ 4227 Å Cs I, D_1 Na I, λ 6103 Å Ca I and λ 5250 Å Fe I. It was found that the dimensions of elements of the large scale velocity field vary with height. Elements of minimal size are near levels of formation of the lines D_1 Na I to λ 5184 Å Mg I. Under these conditions, as well as under other conditions, the maximum magnetic field strengths rises statistically coincide with the zero line of the radiation velocities. At each of the levels the velocity distribution within the element of velocity sign (with a rise or emission of gas) is well described by a cosinusoid (cosine of revolution). In the chromosphere as well as in the photosphere, the horizontal and vertical constituents of the velocity are close. The horizontal velocities rise by a factor of 4 to 5 on going from the level of formation of the line λ 5250 Å Fe I to the level of formation of the line H_{α}. The velocities of the large scale field vary with the solar activity cycle. The observed features of the large scale velocity field can be related to wave motions in the solar atmosphere of the type of gravitational waves. (SJR)

9834 VERTICAL DISTRIBUTION OF A MAGNETIC FIELD IN THE BRIGHT REGION OF THE SUNSPOT PENUMBRA. Gusejnov, M. D. Izv. Krym. Astrofiz. Observ.; 47: 7-13(1973). (In Russian).

From central parts of the absorption lines H_{α}, H_{β}, H_{γ} and H Ca II, and also from a number of strong lines Fe I, Ca I, Na I, Mg I, Ti II and Si II, absolute values of the magnetic field strength H were determined in the chromosphere over a bright formation in the general semishadow of a group of sunspots. The magnetic splitting of the lines $\Delta\lambda_H$ was measured from a polarization spectrogram obtained by means of the slit spectrograph of the solar telescope of the Crimean Astrophysical Observatory. A study was made of the change in magnetic field strength H with height. At the level of the photosphere-chromosphere boundary the magnetic field strength is equal approximately to 600 gauss. With increasing height the magnetic field first becomes stronger (the vertical gradient of the magnetic field strength with height is $\Delta H/\Delta h = +0.75$ gauss/km), and at the level of formation of the central part of the line H_{γ} the magnetic field strength attains a value H = 2000 gauss. Then the field becomes weaker with height: at the levels of occurrence of the central parts of the lines H_{β} and H Ca II relatively fast ($\Delta H/\Delta h = -1.10$ gauss/km) and at higher layers somewhat more slowly ($\Delta H/\Delta h = -0.37$ gauss/km). At the level of formation of the central part of the line H_{α} the magnetic field strength H is about 400 gauss. A discussion is carried out on possible reasons explaining the observed strengthening in magnetic field over the bright region at the level of formation of the central parts of the line H_{γ} in the chromosphere. (SJR)

9835 ON THE CALIBRATION OF PHOTOELECTRIC MEASUREMENTS OF A MAGNETIC FIELD. Kotov, V. A. Izv. Krym. Astorfiz. Observ.; 47: 14-25(1973). (In Russian).

Large divergences are pointed out between recorded values of the magnetic field obtained for the same sunspot by means of the magnetographs of the Crimean Astrophysical Observatory and the Fraunhofer Institute. This difference and the large difference in calibration standards which were used explain the divergence in results dealing with the field configurations in the sunspot. On the magnitograph of the Crimean Astrophysical Observatory, measurements were made of the Zeeman displacements $\Delta\lambda_H$ of the center of gravity of the line during observation with a λ/4 analyzer. An exit slit geometry proposed by Semel' was used for this purpose. In strong fields $\Delta\lambda_H$ gives substantially lower values of the horizontal component H_{II}. However by the method of Semel' it is possible to obtain satisfactory calibration of the magnitograph for weak fields, since the displacements $\Delta\lambda_H$ are a good representation of the longitudinal field at $H_{II} < 250$ gauss. (SJR)

9836 ON TIME CHARGES OF POLARIZATION DURING SOLAR RADIO BURSTS OBSERVED ON OCTOBER 29, 1968 AT 3.15-cm WAVE LENGTH. Eryushev, N. N.; Tsvetkov, L. I. Izv. Krym. Astrofiz. Observ.; 47: 64-70(1973). (In Russian).

Time changes are considered in the degree of circular polarization of solar radiobursts at a wavelength of 3.15 cm. The observations were carried out on Oct. 29th, 1968 on the 22-meter radiotelescope of the Crimean Astrophysical Observatory, Academy of Sciences, USSR. It was found that bursts of radiowaves occurred in three separate groups (trains of waves). The intensity of bursts in each train gradually fell, but the intensity of each succeeding train increased. The third train contains in itself a powerful burst which is accompanied by radiation of type IV. The degree of polarization changes noticeably both from burst to burst independent of intensity, as well as during the bursts themselves. In some cases the course of the change in degree of polarization coincides with the time course of the total intensity; in other cases the peak in degree of polarization occurs somewhat earlier than the maximum in intensity of the burst. The general course in degree of polarization for two extreme trains of waves is reminiscent of quasiperiodic processes: for the first train of a rising type, and for the third train of a dampening type. A relation was found between the magnitude of the degree of polarization of the radiowaves and the hardness of the x rays during the solar bursts. (SJR)

9837 ON THE CIRCULAR POLARIZED EMISSION OVER THE BIPOLAR GROUP OF SUNSPOTS AT 8-mm WAVELENGTH. Efanov, V. A.; Moiseev, I. G. Izv. Krym. Astorfiz. Observ.; 47: 58-63(1973). (In Russian).

Results are presented of a study of the behavior of the circularly polarized component of radiation from a local source of increased brightness at a wave length of 8 mm, which is situated over a bipolar group of sunspots, on passing through the group to the solar disk. Measurements of the intensity of the circularly-polarized component of radiation were characterized by the presence of a maximum over the tail part of the group, when it was at 25 to 30° to the east from the central meridian, and over the head part of the group with its position at the same distance to the west. This behavior is interpreted as an indication of the direction of the magnetic field in the group. The degree of circular polarization in the maxima did not exceed 3%. The observations were carried out on the 22-meter radiotelescope of the Crimean Astrophysical Observatory, Academy of Sciences, USSR in September of 1970. (SJR)

9838 BRIGHTNESS DISTRIBUTION IN SPECTROHELIOGRAMS TAKEN IN SOME SOLAR UV SPECTRUM LINES. Dubov, E. E ; Kartashova, L. G. Izv. Krym. Astrofiz. Observ.; 47: 49-57(1973). (In Russian).

A comparison is made of the brightness distribution in quiet and weakly perturbed regions of the sun on spectroheliograms taken at lines of various ions. Ions of the first group (N, Sh, O IV, O VI) emit mainly in the transition zone from the chromosphere to the corona; ions of the second group (Mg X, Ne V SH and Si XII) are mainly coronal. It turned out that the brightness distribution in quiet and weakly perturbed regions of the solar disk is rather close for lines of various ions within the limits of each group, but is sharply different for lines of ions from different groups. The statistical reliability of this difference corresponds to a significance level of 0.05. Correlation analysis confirms these conclusions. In a number of cases on the spectroheliograms taken at the line 1032 Å of the ion O VI (first group), it is possible to note a coincidence in the arrangement of bright and dark elements with their arrangement on spectroheliograms in lines of the coronal group of ions (second type of brightness distribution). On spectroheliograms taken in the region of 800 Å in the Lyman continuum, very many bright features are observed. The results of comparing brightness distributions on spectroheliograms taken at various ultraviolet lines corresond to predictions of a model of a chromosphere and a transition zone from the chromosphere to the corona, which was proposed earlier by one of the authors. (SJR)

Galaxies

Refer also to abstracts 9730–9731, and 9775.

9839 POSSIBLE EVIDENCE FOR THE RECENT PRODUCTION OF MARKARYAN GALAXIES. Heidmann, J.; Kallaghlian, A. T. (Byuraka Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 9: No. 1, 37-40(1973).

Translated from Astrofizika; 9: No. 1, 71-77(1973).

A list of pairs of Markaryan galaxies with strong ultraviolet continuum is compiled. The statistical considerations show that most of them are physical. However, the observed differences of radial velocities of components of several pairs strongly suggest that a large proportion of these physical systems have positive energy. If so the kinematical ages of these systems are of the order of 10^8 years, which serves as an argument in favor to the recent production of Markaryan galaxies. (auth)

9840 SEARCHES FOR DWARF SPHEROIDAL GALAXIES. Mailyan, N. Sh. (Byuraka Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 9: No. 1, 33-36(1973).

Translated from Astrofizika; 9: No. 1, 63-69(1973).

A total of 104 dwarf spheroidal galaxies were found on the Palomar Sky Survey Charts in the region with $\alpha > 56°$ and $b > 20°$. The spatial density of these objects is estimated to be 10^{-1} Mpc^{-3}. It is shown that the previously noted tendency for galaxies of this type to be concentrated around galaxies of high luminosity is not pronounced. The angular diameter distribution of these objects is represented by $\log N \sim -\log d$. (auth)

9841 CLASSIFICATION OF THE CENTRAL PARTS OF SOME BRIGHT NUCLEI. Mnatsakanyan, R. G. (Byuraka Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 9: No. 1, 29-32(1973).

Translated from Astrofizika; 9: No. 1, 57-62(1973).

The results are given of the 5-point Byurakan classification of the nuclear regions of 87 bright galaxies of different morphological types. (auth)

9842 CENTRAL CONDENSATIONS OF E AND SO GALAXIES. Saakyan, K. A. (Byuraka Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 9: No. 1, 26-28(1973).

Translated from Astrofizika; 9: No. 1, 51-55(1973).

The results are given of the classification of the central parts of 31 elliptic and 29 lenticular galaxies. The majority of the observed galaxies are estimated to be class 3. Starlike nuclei are encountered very seldom. (auth)

9843 SPECTROSCOPIC OBSERVATIONS OF THE GALAXY MARKARYAN 6. Notni, P.; Khachikyan, E. E.; Butslov, M. M.; Gevorkyan, G. G. Astrophysics (Engl. Transl.); 9: No. 1, 20-25 (1973).

Translated from Astrofizika; 9: No. 1, 39-50(1973).

The results are given of spectroscopic observations of the galaxy Markaryan 6 made with the 2-m universal telescope of the Tautenburg Observatory. The spectra were obtained by means of a UAGS spectrograph and a new image tube of the type M-9 shch of the Byurakan Observatory with dispersion 170 Å/mm. The image tube is described. The components of hydrogen lines discovered in 1969 were observed in the spectrum of Markaryan 6 in December 1971 and February 1972. It was confirmed that the broad wings of the lines H_α, H_β, noted previously, exist. It is concluded that the broad wings of the hydrogen lines arose together with the short-wave components as a result of an explosion. The total radiation flux in H_β and its components did not undergo appreciable changes after January 1970. Pronik and Chuvaev's conclusion is confirmed that there are rapid changes of the flux in the continuous spectrum of Markaryan 6. (auth)

9844 DETAILED UBV PHOTOMETRY OF THE SPIRAL GALAXY NGC 2276. Shakhbazyan, R. K. (Byurakan Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 9: No. 1, 9-19(1973).

Translated from Astrofizika; 9: No. 1, 21-37(1973).

The results are given of detailed three-color photometry of the spiral galaxy NGC 2276. The observations were made with the 40″ Schmidt telescope of the Byurakan Observatory. A chart of the distribution of the surface brightness and color indices over the galaxy is given. A 9.7″ × 9.7″ diaphragm was used. The integrated magnitudes and color indices B−V and U−B were determined for the galaxy as a whole, for the nuclear region, the bar, and 16 condensations observed in the galaxy. It is shown that all these condensations are superassociations. The curves giving the distribution of brightness and color along the principal axes of the galaxy and a two-color diagram are constructed. The results of detailed colorimetric observations were used to investigate the dependence of the relative intensities and the mean surface brightness on the color index. (auth)

9845 PHYSICAL CHARACTERISTICS OF THE NUCLEUS OF THE GALAXY MARKARYAN 6. Khachikyan, E. E. (Byurakan Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 9: No. 1, 76-78(1973).

Translated from Astrofizika; 9: No. 1, 139-142(1973).

The changing spectrum of Markarian 6 is discussed and its implications for the classification of Markarian 6 are considered. (WDM)

9846 NATURE OF GALAXIES WITH ULTRAVIOLET CONTINUUM. II. Objects with Broad Emission Lines. Markaryan, B. E. (Byurakan Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 9: No. 1, 1-8(1973).

Translated from Astrofizika; 9: No. 1, 5-19(1973).

A study was made of 46 objects with broad emission lines detected by a number of observers among galaxies with ultraviolet continuum. The Doppler width of the allowed and forbidden lines of these objects is given. The galaxies with broad spectral lines (including Seyfert galaxies) are divided into two types (I and II) on the basis of the energy distribution in the continuous spectrum and the profiles of the emission lines. Type I objects radiate strongly in the ultraviolet and moderately or weakly in the red part of the spectrum. They also have broad allowed and narrow forbidden lines. Type II objects radiate strongly in the red part of the spectrum and moderately or weakly in the ultraviolet, and both their allowed and their forbidden lines are broad. It is predicted that the QSO's include objects of type II. There must be fewer type II than type I objects in the Metagalaxy. (auth)

9847 RADIO EMISSION OF NGC 5128 AT LAMBDA = 1.35 cm. Kaufmann, P.; Scalise, E.; dos Santos, P. M.; Fogarty, W. G. (Univ., Mackenzie, Sao Paulo, Brazil). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 15P-17P(Oct 1974).

The central region of NGC 5128 has been mapped at λ 1.35 cm with an antenna beam of 4′. The integrated flux density fits well on the curve proposed for longer wavelengths with a spectral index of 0.6 and the central radio component still has the same shape and size at λ 1.35 cm as at longer wavelengths. (auth)

9848 EVIDENCE OF THE EVOLUTION OF S-PROCESS ABUNDANCE IN THE INTERSTELLAR MEDIUM. Huggins, P. J.; Williams, P. M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 1P-5P(Oct 1974).

Re-examination of previous analyses of homogeneous groups of unevolved F and G type stars suggests an ageing effect in the interstellar medium in the sense of an increase with time of the ratio of the abundances of s-process elements to those of the iron peak. This is consistent with recent models of galactic evolution in which s-process elements were synthesized in low mass stars. (auth)

9849 AGE-DEPENDENCE OF THE LOCAL STELLAR VELOCITY DISTRIBUTION. Byl, J. (Univ. of British Columbia, Vancouver). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 157-170 (Oct 1974).

Relations between the velocity distribution and spectral type were found for the nearby stars of Gliese's catalogue. Ages were estimated for some of the stars and hence the dependence of the velocity dispersions on age could be determined. It was found that the resulting age-dependence could be accounted for if the spiral arms had dissolved and reformed a number of times. (auth)

9850 AN IMPROBABLE COINCIDENCE IN NGC 985: A RING GALAXY WITH A SEYFERT NUCLEUS. de Vaucouleurs, G.; de Vaucouleurs, A. (McDonald Observatory, The University of Texas). Astrophys. J. Lett. 197: No. 1, L1-L4 (1 Apr 1975).

The compact spheroidal component of the ring galaxy NGC 985=VV 285 was found to possess a Class 1 Seyfert nucleus having narrow [O III] lines and broad Balmer lines (half-width $\simeq 5500$ km s^{-1}) with narrow cores (half-width <200 kms s^{-1}). The mean redshift of the system is $z=0.0432$ corresponding to a Hubble distance $\Delta=130h^{-1}$ Mpc ($h=H/100$). The absolute magnitude about -22, and the ring diameter $D\simeq 22$ kpc (for $h=1$) make it one of the largest and brightest known ring systems. It is compared with other ring galaxies in the context of the theory of Freeman and de Vaucouleurs according to which these objects result from collisions of normal spirals with intergalactic gas clouds. Since the probability that a randomly selected Sa-Sc spiral suffered such a collision in the past 0.5×10^9 years (to still appear as a ring) is $\sim10^{-4}$, and the probability that the nucleus of a giant spiral is currently in a Seyfert phase is $\sim10^{-2}$, the combined probability of the simultaneous occurrence of these unrelated events is $\sim10^{-6}$. (auth)

9851 EVIDENCE FOR THE DETECTION OF GAMMA RAYS FROM CENTAURUS A AT $E_\gamma \geq 3\times10^{11}$ eV. Grindlay, J.E.; Helmken, H.F. (Center for Astrophysics, Harvard College Observatory); Brown, R.H.; Davis, J.; Allen, L.R. Astrophys. J. Lett. 197: No. 1, L9-L12 (1 Apr 1975). L.R. Astrophys. J. Lett. 197: No. 1, L9-L12 (1 Apr 1975).

Results of extended observations of the active galaxy NGC 5128 (Cen A) at energies $>10^{11}$ eV are presented. Data were recorded from three observing periods (1972–1974) in Australia. The atmospheric Cerenkov technique was used, together with partial cosmic-ray rejection, to search for γ-ray-initiated extensive air showers from the direction of Cen A. A 4.5 σ (time-averaged) excess over background was detected. Some implications of this probable γ-ray flux are discussed. (auth)

9852 DISCOVERY OF INTERSTELLAR METHYL FORMATE. Brown, R.D.; Crofts, J.G. (Department of Chemistry, Monash University, Melbourne, Australia); Gardner, F.F.; Godfrey, P.D.; Robinson, B.J.; Whiteoak, J.B. Astrophys. J. Lett. 197: No. 1, L29-L31 (1 Apr 1975).

The 1_{10}-1_{11} A-state transition of methyl formate $HCOOCH_3$ has been detected in emission in the spectrum of Sgr B2. With a laboratory determination of 1610.249 MHz for the rest frequency of the transition, the radial velocity of the observed line is 53 ± 6 km s^{-1}. The nearby E-state transition at 1610.906 MHz may also have been detected. It is probable that the 1_{10} and 1_{11} levels are inverted and that the continuum emission of Sgr B2 is being amplified. (auth)

9853 BROAD BALMER EMISSION LINES IN RADIO GALAXIES. Osterbrock, D.E.; Koski, A.T.; Phillips, M.M. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz). Astrophys. J. Lett. 197: No. 2, L41-L44 (15 Apr 1975).

The radio galaxies 3C 382, 3C 390.3 and 3C 445 have very broad Balmer emission lines, with irregular profiles that are probably due to massive motions in the ionized gas. Detailed spectrophotometric results for 3C 390.3 show that its forbidden-line spectrum is similar to that of Cyg A, except that the mean density is higher in 3C 390.3. The density is much higher ($N_e \gtrsim 10^{8.5}$ cm^{-3}) in the broad Balmer-line region. Approximately one-fourth of the emission-line radio galaxies observed to date in our program have broad Balmer lines. The phenomenon is probably similar to that in Class 1 Seyfert galaxies, but more intensive in the radio galaxies, but more intensive in the radio galaxies. (auth)

9854 MICROWAVE OBSERVATIONS OF THE RHO OPHIUCHI DARK CLOUD. Chaisson, E.J. (Center for Astrophysics, Harvard College Observatory). Astrophys. J. Lett. 197: No. 2, L65-L68 (15 Apr 1975).

Observations of the 158α recombination-line spectrum toward the dark cloud ρ Oph show evidence for two features, which, if the cloud is quiescent as seems evident from molecular observations, are most reasonably attributed to carbon and probably sulfur. Given this interpretation, the apparent elemental depletion suggested by these microwave experiments agrees well with relative interstellar abundances derived from ultraviolet studies made with the *Copernicus* satellite, with Field's condensation-accretion theory of grain formation, and with the Carrasco, Strom, and Strom notion that grains grow in dense regions at the expense of heavy-element depletion. An attempted observation of Zeeman splitting of OH also suggests that if a uniform. longitudinal magnetic field exists, it must be $\lesssim 0.5$ miligauss over much of the central part of the ρ Oph cloud. (auth)

9855 OBSERVATIONS OF CIRCULAR POLARIZATION OF THE $J=2-1$, $v=1$ TRANSITION OF THE SiO MASER. Johnson, D.R.; Clark, F.O. (National Bureau of Standards). Astrophys. J. Lett. 197: No. 2, L69-L72 (15 Apr 1975).

Circular polarization has been observed in the $J=2-1$, $v=1$ SiO emission from the Orion A molecular source (OMC 1). The net polarization was observed at two different times separated by three days. (auth)

9856 OBSERVATIONS OF THE $J=1\rightarrow0$ TRANSITIONS OF THE ^{13}C ISOTOPIC SPECIES OF CYANOACETYLENE (HCCCN) IN THE DIRECTION OF SAGITTARIUS B2. Gardner, F.F. (Division of Radiophysics, CSIRO, Sydney, Australia); Winnewisser, G. Astrophys. J. Lett. 197: No. 2, L73-L76 (15 Apr 1975).

The isotopic species HC^{13}CCN and HCC^{13}CN of cyanoacetylene have been detected in Sgr B2 at 9.06 GHz. An *upper* limit to the abundance ratio $^{12}C/^{13}C$ of 36 ± 5 is obtained for the gas in front of the continuum source. The ratio of the $F=1\rightarrow1$ to the $F=2\rightarrow1$ hyperfine transitions is lower than the LTE value of 0.6, a similar result to that found previously for the ^{12}C species. (auth)

9857 MISSING MASS AROUND GALAXIES: MORPHOLOGICAL EVIDENCE. Einasto, J. (Astrophysical Observatory, Tallin, USSR); Saar, E.; Kaasik, A.; Chernin, A. D. Nature (London); 252: No. 5479, 111-113(8 Nov 1974).

It is stated that empirical evidence has been obtained on the important role of what is termed "hidden" matter in the dynamics of single and double galaxies. It appears that such matter is concentrated around massive galaxies to form coronas; and that the total mass of the galaxies is about one order of magnitude greater than the mass of their visible parts. Massive galaxies are known to be surrounded by clusters of small companion galaxies, and a correlation has been discovered between the morphological types of companion galaxies and their distances from the parent galaxies. This correlation is examined. (UK)

9858 CELESTIAL DISTRIBUTION OF GALACTIC GAMMA RADIATION. Schlickeiser, R.; Thielheim, K. O. (Kiel Univ. (F. R. Germany). Inst. fuer Reine und Angewandte Kernphysik). Astron. Astrophys.; 34: No. 1, 167-169(Aug 1974).

The celestial distribution of gamma ray intensity is calculated on the basis of relations between interstellar hydrogen and cosmic ray gas densities and the strength of the interstellar magnetic field for which a model is used. Results are compared with empirical data from the OSO-3 experiment of Kraushaar et al. (1972) and discussed with respect to equilibrium conditions of the galactic disk. (orig.)

9859 "TWIN-EXHAUST" MODEL FOR DOUBLE RADIO SOURCES. Blanford, R. D.; Rees, M. J. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 3, 395-415(Dec 1974).

A mechanism is proposed for the formation of radio components in strong double sources such as Cygnus A. Relativistic plasma generated in an active galactic nucleus cannot escape isotropically if the nucleus is surrounded by too much dense thermal gas. There is, however, a possible equilibrium flow in which the plasma escapes along two oppositely-directed channels or "exhausts". At all points on the boundary of these channels, the pressure of the relativistic (possibly magnetized) plasma must balance the pressure of the static thermal gas cloud. The outflow velocity becomes sonic (implying, for ultra-relativistic plasma, a velocity $c/\sqrt{3}$) where the external pressure is $\approx \frac{1}{2}$ its central value. The channel cross-section reaches a minimum value at this point. The channel then widens again as the external pressure drops still further, and, as in a de Laval nozzle, the flow becomes supersonic. Relativistic plasma can thus be collimated into two relativistic beams. Hargrave and Ryle's (Mon. Not. R.astr. Soc.; 166:305 (1974)) high-resolution maps of Cygnus A reveal "hot spots" $\lesssim 2$ kpc in size at the outer edge of each individual component into which (it is believed)

energy is being continuously supplied. These hot spots are identified with the regions where the beams impinge on the intergalactic medium. The dimensions and radio luminosity of Cygnus A imply that the central galactic nucleus must have maintained a power output $\sim 10^{46}$ erg s^{-1} for 10^6 to 10^7 yr. This outflow could have been collimated into two sufficiently narrow beams if the galactic nucleus were surrounded by gas with T $\simeq 10^8$ K, density $\sim 10^3$ particles cm^{-3} and scale height ~ 200 pc. Some aspects of the detailed morphology of Cygnus A are also interpreted on the basis of this general model. The possible role of instabilities in the flow pattern, and the influence of magnetic fields, is discussed. Applications to other sources (which generally require less extreme parameters than Cygnus A) are briefly considered. (auth)

9860 MEASUREMENT OF THE SPECTRUM OF THE SUBMILLIMETER COSMIC BACKGROUND. Woody, D.P.; Mather, J.C.; Nishioka, N.S.; Richards, P.L. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. Lett. 34: No. 16, 1036-1039 (21 Apr 1975).

The spectrum of the night sky has been measured in the frequency range from 3 to 40 cm^{-1} using a fully calibrated liquid-helium-cooled balloon-borne spectrophotometer at an elevation of 39 km. A model based on the known molecular parameters was used to subtract the atmospheric emission. In the frequency range from 4 to 17 cm^{-1}, the spectrum of the background radiation is that of a blackbody with a temperature of $2.99^{+0.07}_{-0.14}$ K. (auth)

9861 POSSIBLE MASER RADIATION IN SOME LINES OF THE H_2O ROTATIONAL SPECTRUM. Shmeld, I.K. (Radio Astrophysical Observatory, Academy of Sciences of the Latvian SSR). Sov. Astron.—AJ 18: No. 5, 658-659 (Mar 1975).

The possibility in principle of chemical and collisional maser pumping in 27 rotational transitions of the H_2O molecule is investigated. In addition to the $6_{16}-5_{23}$ transition at $\lambda = 1.35$ cm, population inversion can occur for 18 transitions in the wavelength range 150–1650μ. In the strongest emission lines the flux density may reach $10^{-23}-10^{-22}$ $W \cdot m^{-2} \cdot Hz^{-1}$. (auth)

9862 ABSORPTION OF MASER RADIATION OF W75S IN A HYDROXYL CLOUD. Lekht, E.E. (Shternberg Astronomical Institute, Moscow). Sov. Astron.—AJ 18: No. 5, 657-657 (Mar 1975).

Observations of the 1667-MHz OH absorption line in the direction of DR 21 carried out at Nancay, France, with high-frequency resolution are reported. The -0.65 – km/sec component of the 1665-MHz maser radiation of W75S is partially absorbed in a cold OH cloud. (auth)

9863 LARGE-SCALE STRUCTURE IN THE RADIO CONTINUUM NEAR THE GALACTIC CENTER. Ariskin, V.I.; Berulis, I.I. (Lebedev Physics Institute, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 5, 539-542 (Mar 1975).

Continuum observations of the galactic-center region at $\lambda = 21.1$ cm, carried out with the RT-22 radio telescope, yield estimates for the physical parameters of the ionized medium along the direction toward the center. A model is proposed for the large-scale distribution of the medium. (auth)

9864 STRUCTURE OF THE GALACTIC BACKGROUND. Vaisberg, V.V. (Institute of Radiophysics and Electronics, Academy of Sciences of the Ukrainian SSR). Sov. Astron.—AJ 18: No. 5, 543-545 (Mar 1975).

Some topics concerning the interpretation of high-latitude galactic radio emission and the nature of the galactic loops are discussed. The suggestion is made that if Loop I represents the remnant of a nearby supernova, then there should be observable effects caused by the influence of the local regular magnetic field on the expansion of the supernova envelope. The isophotoes obtained by Yates are analyzed from this point of view. (auth)

9865 APPROXIMATE SOLUTIONS OF RADIATIVE TRANSFER IN DUSTY NEBULAE. I. PURE HYDROGEN NEBULAE. Petrosian, V.; Dana, R.A. (Institute for Plasma Research, Stanford University). Astrophys. J. 196: No. 3, 733-744 (15 Mar 1975).

This is the first of a series of papers dealing with transfer of radiation in dusty nebulae. The formulae for the general problem are presented. This paper discusses nebulae containing dust and hydrogen. Approximate solutions, accurate to within 50 percent, are obtained for spherical nebulae containing purely absorbing dust. Less accurate solutions are presented for the general case of scattering and absorbing dust. The results are presented in a form convenient for calculating the required number of ionizing photons, the fractional ionization of hydrogen, and the fractions of ionizing photons absorbed by dust and gas in terms of size, hydrogen density, dust albedo, and optical depth. Explicit relations between these quantities are obtained for uniform nebulae. Simple integrals are presented for calculating the above quantities for spherically symmetric nebulae with nonuniform gas and dust distribution. (auth)

9866 DISTRIBUTION OF 73-GHz PARA-FORMALDEHYDE LINE EMISSION IN THE ORION NEBULA. Kaifu, N.; Iguchi, T. (Department of Astronomy, University of Tokyo); Morimoto, M. Astrophys. J. 196: No. 3, 719-722 (15 Mar 1975).

The $1_{01}-0_{00}$ transition of para-formaldehyde (72.8381 GHz) has been observed for 10 points in Ori A by the 6-m millimeter-wave telescope at Mitaka. The emission has been found to be extended to the north direction compared with the 2-mm lines of formaldehyde; the north-south extension of the 73-GHz line emission is about 6'. The distribution of the excitation temperature of para-formaldehyde in the Orion molecular cloud is discussed. The column density of para-formaldehyde is estimated to be $2 \sim 5 \times 10^{13}$ cm^{-2}. (auth)

9867 INTERSTELLAR CARBON MONOSULFIDE. Liszt, H.S. (National Radio Astronomy Observatory, Green Bank, West Virginia); Linke, R.A. Astrophys. J. 196: No. 3, 709-717 (15 Mar 1975).

We have measured intensities of the $J = 3-2, 2-1$, and $1-0$ transitions of carbon monosulfide in five molecular clouds associated with galactic H II regions. The two higher-lying lines were mapped in each source, and the lowest line, $J = 1-0$, was observed at the map centers. The observed intensity ratio are shown to be dominated by effects of instrumental resolution. The observations are corrected for these effects and discussed in terms of recently published calculations for radiative transfer in collapsing clouds. (auth)

9868 STRONG SCINTILLATIONS IN ASTROPHYSICS. I. THE MARKOV APPROXIMATION, ITS VALIDITY AND APPLICATION TO ANGULAR BROADENING. Lee, L.C.; Jokipii, J.R. (Downs Laboratory of Physics, California Institute of Technology). Astrophys. J. 196: No. 3, 695-707 (15 Mar 1975).

The Markov approximation to the propagation of waves in an extended, irregular medium is discussed in an astrophysical context. A new derivation is presented which is simple and which shows that the assumption of Gaussian statistics used by previous authors is irrelevant. We discuss the relevance of the approximation and show that it may apply in many situations of interest, including interstellar scintillations of pulsar signals. The approximation does not require the assumption of weak scattering or Gaussian correlation functions. The Markov equation for the angular spectrum is particularly simple, and solutions are discussed for typical turbulence spectra. It is found that the equation for the angular spectrum is very nearly that used by previous authors, and the present discussion shows that these results are much more general than previously thought. A possible observational test for distinguishing between Gaussian and power-law interstellar density spectra is discussed. (auth)

9869 BINARY GALAXIES AND THE PROBLEM OF MASSES OF CLUSTERS OF GALAXIES. Noonan, T.W. (Brockport State College, Brockport, New York). Astrophys. J. 196: No. 3, 683-686 (15 Mar 1975).

The question of whether galaxies' masses $\mathfrak{M}$ and luminosities L may be related by a power law $\mathfrak{M} \propto L^{2.5B}$ rather than a direct proportionality is raised in relation to two problems. First, the effect of $B \neq 0.4$ on the problem of galaxy-cluster masses is examined. Second, a preliminary investigation of binary elliptical galaxies suggests $B = 0.3 \pm 0.1$ (s.e.). A value of $B = 0.3$, with a mass-luminosity ratio of 260 for the brightest cluster member as suggested by Jenner's work, indicates a typical cluster mass-luminosity ratio of 580. (auth)

9870 SHAHBAZIAN 123: A NEW DISTANT COMPACT GROUP OF COMPACT GALAXIES. Mirzoyan, L.V. (Byurakan Astrophysical Observatory, Armenia, USSR); Miller, J.S.; Osterbrock, D.E. Astrophys. J. 196: No. 3, 687-688 (15 Mar 1975).

Image-tube scanner spectrograms were taken of seven objects in two Shahbazian compact groups of compact objects. The three brightest objects in Shahbazian 78 are all late-type stars. On the other hand, three of the brightest objects in Shahbazian 123 are luminous compact galaxies with $z = 0.115$, while a fourth is likely also to be a galaxy in the group. (auth)

Cosmology

Refer also to abstracts 9860, 10685, 10704, and 10709.

9871 RELATIVISTIC MOTION OF A GYROSCOPE AROUND THE MOON. Mazeh, T.; Katz, J. (Hebrew Univ., Jerusalem). Nuovo Cim.; 25B: No. 1, 399-404(11 Jan 1975).

The general-relativistic effect on the motion of the axis of a free-falling gyroscope around the Moon was calculated. The Lense–Thirring effect is not measurable. The main effect coming from Einstein's theory and from other metric theories is measurable and a zero-measurement may be performed along equatorial orbits. (auth)

9872 ASYMPTOTICALLY FLAT SPACE–TIMES. Coleman, C. J. (Imperial Coll., of Science and Tech., London). J. Phys., A (London); 7: No. 15, 1858-1865(11 Oct 1974).

Relations between harmonic and radiating coordinates are investigated for the case of asymptotically flat space–times, and an approximation to the "Bondi news function" in terms of the energy-momentum tensor is found. (auth)

9873 ENERGY-MOMENTUM DENSITY OF A SHOCK WAVE. Legros, A.; Madore, J. (Univ., Paris). J. Phys., A (London); 7: No. 15, 1887-1890(11 Oct 1974). (In French).

An expression is proposed for the energy-momentum density of a first-order gravitational shock wave. (auth)

9874 TEORIYA TYAGOTENIYA V ORTOGONAL'NOM REPERE. (Gravitation Theory in Orthogonal Reference Points). Rodichev, V. I. Moscow; Izdatel'stvo Nauka (1974). 184p.

A description of gravitation theory is given by means of the formalism of orthogonal reference points (tetrad), making it possible to represent all results of the theory and not only the Einstein equations in the general covariant form. Many relations of gravitation theory repeat the relations of electrodynamics. This makes possible an approach to a physical interpretation of the apparatus of the theory. Simple expressions for the complexes of energy and momentum of gravitational fields are established. A series of exact wave solutions of the Einstein equations are examined. Questions on the energy transfer of gravitational waves are analyzed. The difficulties of the theory, connected with the determination of the energy and momentum of gravitational fields, are examined in detail. Special attention is given to a description of the geometric representation of the frame of reference. Basically the Einstein hypothesis is stated so that the metrics of the noninertial system is explained by the local Lorentz contraction. Examples are given of metrics having different symmetry character. The formalism of orthogonal reference points and its use is discussed in a form suitable for independent study by both scientific workers and university students. (tr-auth)

9875 POST-NEWTONIAN HYDRODYNAMICS IN JORDAN'S THEORY. Baranov, A. A. (Inst. of Heat and Mass Exchange, Minsk). Astrophysics (Engl. Transl.); 9: No. 1, 51-53(1973).

Translated from Astrofizika; 9: No. 1, 95-98(1973).

Post-Newtonian hydrodynamics is constructed in Jordan's theory of gravitation, which includes, as special cases, the post-Newtonian hydrodynamics in Einstein's theory and in the Brans–Dicke theory. The propagation of small perturbations in post-Newtonian Jordan hydrodynamics is considered. The fundamental possiblity of verifying Jordan's theory by precision acoustic measurements is pointed out. (auth)

9876 INTERGALACTIC DUST. Nandy, K.; Morgan, D. H.; Reddish, V. C. (Royal Observatory, Edinburgh). Mon. Notic. Roy. Astron. Soc.; 169: No. 1, 19P-26P(Oct 1974).

The obscuration of extragalactic objects by intergalactic dust has been calculated as a function of redshift for three received frequencies assuming that the dust particles obey the typical interstellar extinction law. The effect of the 2200 Å feature, characteristic of interstellar extinction, is to produce broad maxima in the resulting intergalactic reddening vs redshift curves. The redshift variation of the colors of quasars, corrected for emission lines and galactic reddening, cannot be explained by luminosity evolution but can be interpreted in terms of reddening by intergalactic dust whose extinction properties show the ultraviolet peak near 2200 Å. An upper limit of the mass density of this dust has been estimated. (auth)

9877 EINSTEIN'S INTERIOR FIELD EQUATIONS IN CHARGED ELASTIC MEDIA. Roy, S. R.; Singh, P. N. (Banaras Hindu Univ., India). J. Phys., A (London); 7: No. 15, 1866-1870 (11 Oct 1974).

In a preceding paper, a solution of the field equations of general relativity for an elastic sphere of constant density was obtained (Roy. S. R., Singh, P. N. J. Phys. A. Math. Nucl. Gen.; 6: 1862 (1973)). The purpose of the present investigation is to obtain a solution of the charged elastic fluid distribution in general relativity. (auth)

9878 STATIONARY SPERICALLY SYMMETRIC ONE-KINK METRIC IN GENERAL RELATIVITY. Williams, J. G. (Univ., Brussels). J. Phys., A (London); 7: No. 15, 1871-1883(11 Oct 1974).

It can be shown that general relativity admits structures that are strictly conserved in number for topological reasons. Such objects, called "kinks," are associated with the particular form of the metric and it has been shown that a kink has many of the properties expected of a classical analogue of a Fermi particle. This paper examines the general form of a stationary spherically symmetric metric corresponding to a single kink centred at the origin. This is a generalization of the usual spherically symmetric Schwarzschild case. The Einstein tensor is deduced for this system, and it is shown that there is no free-field solution for this case. It is indicated how possible extensions, such as the inclusion of electric charge, may lead to the possibility of solutions. (auth)

9879 ACTION PRINCIPLE FOR THE MOTION PARTICLES. Dirac, P. A. M. (Florida State Univ., Tallahassee). Gen. Relativity Gravitation; 5: No. 6, 741-748(Dec 1974).

An action principle is set up for the motion of charged matter in the presence of the Einstein gravitational field. It can be applied to the motion of an extended particle and avoids the difficulties of a point particle arising from the singularities in the field. (auth)

9880 NOTE ON PROPER HOMOTHETIC MOTIONS. Sigal, R. (Univ. of Alberta, Edmonton, Can.). Gen. Relativity Gravitation; 5: No. 6, 737-739(Dec 1974).

It is shown that the only Ricci-flat space–time to support a time-like proper homothetic motion with hypersurface orthogonal trajectories is flat space. (auth)

9881 SPACE TENSORS IN GENERAL RELATIVITY. III. The Structural Equations. Massa, E. (Univ., Genoa). Gen. Relativity Gravitation; 5: No. 6, 715-736(Dec 1974).

A self-consistent theory of spatial differential forms over a pair (M,Γ) is proposed. The operators $\tilde{d}$ (spatial exterior differentiation), $\tilde{d}_T$ (temporal Lie derivative) and $\tilde{L}$ (spatial Lie derivative) are defined, and their properties are discussed. These results are then applied to the study of the torsion and curvature tensor fields determined by an arbitrary spatial tensor analysis $(\tilde{\nabla},\tilde{\nabla}_T)$ over (M,Γ). The structural equations of $(\tilde{\nabla},\tilde{\nabla}_T)$ and the corresponding spatial Bianchi identities are discussed. The special case $(\tilde{\nabla},\tilde{\nabla}_T) = (\tilde{\nabla}^*,\tilde{\nabla}_T^*)$ is examined in detail. The spatial resolution of the Riemann tensor of the manifold M is finally analyzed; the resulting structure of Einstein's equations over a pair (ν_4,Γ) is established. An application to the study of the problem of motion in terms of co-moving atlases is proposed. (auth)

9882 ENERGY TENSOR OF MATTER IN THE PROJECTIVE THEORY OF RELATIVITY. Lessner, G. (Univ., Konstanz, Ger.). Gen. Relativity Gravitation; 5: No. 6, 699-714(Dec 1974).

In the projective theory of relativity the 5-dimensional field equation $R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R^5 = T_{\mu\nu}$ and the resulting equation of motion $T^{\mu\nu} = 0$ are investigated. There $T_{\mu\nu}$ stands for the 5-dimensional tensor of macroscopic matter. The 4-dimensional field equations and equation of motion obtained by projection are a generalization of Einstein's theory of general relativity and Maxwell's electrodynamics, involving a scalar field ϕ. They contain a single constant ϕ_0. The weak field approximation is investigated for the case of an ideal fluid and leads to Newton's mechanics, including Newton's gravitational law, and to Maxwell's electrodynamics. For the constant ϕ_0 one obtains the approximate value $\phi_0 \approx c^4/\gamma_N$ with Newton's gravitational constant γ_N. For homogeneous and isotropic cosmological models consisting of matter only the general solution for the radius K of curvature is given. This solution is independent of the equation of state of matter. For a pure dust universe the general solution for the scalar field ϕ is given. For a closed universe a power law $\phi \sim K^{-1}$ is valid which leads to Mach's principle. The calculation of the age of a closed universe yields over 7×10^9Y, if one uses mean values of the present cosmological data. (auth)

9883 GRAVIDYNAMICS OF LINEAR SPIN TWO NEUTRAL FIELDS. Aragone, C.; Restuccia, A.; Siri, R. (International Centre for Theoretical Physics, Trieste, Italy). Gen. Relativity Gravitation; 5: No. 6, 643-655(Dec 1974).

The dynamics of a gravity spin two field system is analyzed when linear antisymmetric formulations for the "matter" field is assumed and the minimal prescription for the interaction is made. It is shown that this interacting system is equivalent to a non-minimally coupled spin-two field when it is given in terms of the symmetric first-order representation. The relevance of considering the full interacting system (instead of treating gravity as external) is stressed throughout. (auth)

9884 PLANE SYMMETRIC SOLUTION OF EINSTEIN'S FIELD EQUATIONS OF GENERAL RELATIVITY CONTAINING ZERO-REST-MASS SCALAR FIELDS. Singh, T. (Univ., Gorakhpur, India). Gen. Relativity Gravitation; 5: No. 6, 657-662(Dec 1974).

An exact static solution of Einstein's field equations of general relativity in the presence of zero-rest-mass scalar fields has been obtained when both the metric tensor g_{ij} and the zero-rest-

mass scalar field ϕ exhibit plane symmetry in the sense of Taub (Ann. Math.; 53: 472-490 (1951)). The solution generalizes the empty space–time solution with plane symmetry previously obtained by Taub to the situation when static zero-rest-mass scalar fields are present. The static plane symmetric solutions of Einstein's field equations in the presence of massive scalar fields, and the difference between the massless and non-massless scalar fields are being investigated. (auth)

9885 NEUTRON STARS AND INCOMPRESSIBLE FLUID SPHERES IN THE JORDAN–BRANS–DICKE THEORY OF GRAVITATION. Hillebrandt, W.; Heintzmann, H. (Technische Univ. Darmstadt, Ger.). Gen. Relativity Gravitation; 5: No. 6, 663-672(Dec 1974).

Neutron stars and incompressible fluid spheres are considered in the Jordan–Brans–Dicke theory (Rev. Mod. Phys.; 34: 596 (1962)). It is shown that their parameters (mass, radius, surface redshift) do not differ appreciably from the corresponding Einstein values even for $\omega = 0$ and various semirealistic equations of state. For incompressible fluid spheres the differences between both theories of gravitation are most pronounced. An apparent instability of the incompressible fluid is found. (auth)

9886 NON-STATIC ELECTROMAGNETIC FIELDS IN GENERAL RELATIVITY. IV. Bera, K. (Presidency Coll., Calcutta); Datta, B. K. Gen. Relativity Gravitation; 5: No. 5, 483-490(Oct 1974).

An investigation is made of Rainich's "already unified field theory" from the standpoint of continuous groups of motions, and a solution is obtained for the case where the electromagnetic field is nonstatic and the space–time admits a three-parameter continuous group of motions whose minimum invariant varieties are three-dimensional spaces. There exists a divergence-free electromagnetic field for values of t at which the metric is not singular. (auth)

9887 NEWTONIAN VIEW OF RELATIVISTIC COSMOLOGY. Evans, A. B. (Otago Univ., Dunedin, New Zealand). Nature (London); 252: No. 5479, 109-110(8 Nov 1974).

It is stated that despite the success of Milne and McCrea (Quart. J. Math. 5: 73 (1974)) in applying classical mechanics to the Friedmann universes Newtonian cosmology has been of only limited use for exploring relativistic world models. The formulation of Newtonian universes in general leads to indeterminate equations of motion. This communication, however, outlines a way of resolving the indeterminacy and obtaining an insight into relativistic cosmology, by equations that treat the dynamics of relativistic dust world models in a quasi-Newtonian fashion. (UK)

9888 CLASS OF NONUNIFORM COSMOLOGICAL MODELS. Date, T. H. (Shivaji Univ., Kolhapur, India). Indian J. Pure Appl. Math.; 4: No. 7-8, 612-619(1973).

A class of nonuniform cosmological models filled with irrotational and shear-free thermodynamical perfect fluid with an infinite conductivity and constant magnetic permeability have been obtained as exact solutions of the field equations proposed by Lichnerowicz. The caloric equations of incompressible fluid, the fluid in which the velocity of light and the velocity of sound are equal and of the "degenerate fluid" are studied. For particular values of the parameters, the solutions reduce to those obtained by McVittie, Schwarzschild, deSitter, Prasanna, Nordström-Jeffery, Bonner and Das. (auth)

9889 ANALYSIS OF THE OPTICAL DATA ON THE DEFLECTION OF LIGHT IN THE VICINITY OF THE SOLAR LIMB. Merat, P. (Univ., Paris). Gen. Relativity Gravitation; 5: No. 6, 757-764(Dec 1974).

Analysis of most observations of the deflection of light near the solar limb establishes the validity of general relativity's prediction beyond a certain distance of the sun and the existence of a new effect which is significant in the close vicinity of the solar limb. (auth)

9890 REFINEMENT OF MEASURABILITY ANALYSIS OF THE LINEARIZED GRAVITATIONAL FIELD. McLoughlin, A. M.; Smith, G. J. (Fordham Univ., New York). Gen. Relativity Gravitation; 5: No. 6, 749-755(Dec 1974).

Second order transitions of a molecular detector employed in a Gedanken experiment devised for measurability analysis of the electric-type components of the linearized Weyl tensor are considered. It is found that the adjustability of the detectors permits probable excitations to involve either absorption of two gravitons of energy $\hbar\omega$ or absorption of a single graviton of energy $2\hbar\omega$, where ω is the resonant frequency of the detector. However, the covariant character of the vibrational momentum is discovered to be crucial for understanding the relative efficacy of mechanisms for the latter sort of transitions. (auth)

9891 POSSIBILITY OF SUPERLUMINAL SOURCES AND THEIR DOPPLER EFFECT. Mignani, R.; Recami, E. (Univ., Catania, Italy). Gen. Relativity Gravitation; 5: No. 5, 615-620 (Oct 1974).

From the special relativity theory, the existence of superluminal reference-frames and faster-than-light objects can be inferred, when its validity is not arbitrarily confined to subluminal velocities. The "extended theory of relativity" allows in particular extending the Doppler effect formulae to superluminal sources. This point is here explored, due to its possible astrophysical interest. Some other questions are briefly considered, regarding the possibility of "radio contact" between subluminal and superluminal objects. (auth)

9892 NUT SOLUTION AS A GRAVITATIONAL DYON. Dowker, J. S. (Univ. of Manchester, Eng.). Gen. Relativity Gravitation; 5: No. 5, 603-613(Oct 1974).

Linearized theory suggests that the NUT solution of Einstein's equations corresponds to a source with both mass and dual mass, i.e., to a gravitational dyon. This is borne out by the striking identity between the killing operators of the NUT solution and the "total angular momentum" operators of the monopole. On this basis, Misner's (J. Math. Phys.; 4: 924 (1963)) periodic time condition is shown to be the analogue of the Dirac quantization, and results from the requirement that the generators integrate to a global Lie group. It is also shown that there are no bound states for a Klein–Gordon field in NUT space provided the field vanishes in the conventional way at the horizon. For this purpose a generalized "tortoise coordinate" is introduced. (auth)

9893 NEW FORM OF GRAVITATIONAL INTERACTION WITH RESPECT TO CONFORMALLY FLAT SPACE. Sokolik, H. (Tel Aviv Univ., Israel). Gen. Relativity Gravitation; 5: No. 5, 599-602(Oct 1974).

Following work reported by Sokolik and Konopleva (Doklady Akad. Nauk, SSSR; 169: 539 (1966)) in which a new form of conformally invariant wave equation is studied, further elaboration is here considered. The gravitational interaction with respect to conformally flat space is studied. (UK)

9894 CLASS OF SINGULAR SPACE–TIMES. Ihrig, E.; Sen, D. K. (Univ. of Toronto). Gen. Relativity Gravitation; 5: No. 5, 593-597(Oct 1974).

A singularity theorem for a certain class of space–times is prepared. The theorem contains an "energy" condition stronger than Hawking's (Proc. Roy. Soc.; A294: 511 (1966) and A295: 490 (1966) and A300: 187 (1967)), but does not require any condition about Cauchy Surfaces, normals or time orientability. (auth)

9895 SPACE TENSORS IN GENERAL RELATIVITY. II. Physical Applications. Massa, E. (Univ., Genoa). Gen. Relativity Gravitation; 5: No. 5, 573-591(Oct 1974).

The general theory of space tensors is applied to the study of a space–time manifold ν_4 carrying a distinguished time–like congruence Γ. The problem is to determine a physically relevant spatial tensor analysis $(\tilde{\nabla},\tilde{\nabla}_T)$ over (ν_4,Γ), in order to proceed to a correct formulation of Relative Kinematics and Dynamics. This is achieved by showing that each choice of $(\tilde{\nabla},\tilde{\nabla}_T)$ gives rise to a corresponding notion of "frame of reference" associated with the congruence Γ. In particular, the frame of reference (Γ,∇^*) determined by the standard spatial tensor analysis $(\tilde{\nabla}^*,\tilde{\nabla}_T^*)$ is shown to provide the most natural generalization of the concept of frame of reference in classical physics. The previous arguments are finally applied to the study of geodesic motion in ν_4. As a result, the general structure of the gravitational fields in the frame of reference (Γ,∇^*) is established. (auth)

9896 SPACE TENSORS IN GENERAL RELATIVITY. I. Spatial Tensor Algebra and Analysis. Massa, E. (Univ., Genoa). Gen. Relativity Gravitation; 5: No. 5, 555-572(Oct 1974).

A pair (M,Γ) is defined as a Riemannian manifold M of normal hyperbolic type carrying a distinguished time-like congruence Γ. The spatial tensor algebra $\tilde{\mathcal{T}}$ associated with the pair (M, Γ) is discussed. A general definition of the concept of spatial tensor analysis over (M,Γ) is then proposed. Basically, this includes a spatial covariant differentiation $\tilde{\nabla}$ and a time-derivative $\tilde{\nabla}_T$, both acting on $\tilde{\mathcal{T}}$ and commuting with the process of raising and lowering the tensor indices. The torsion tensor fields of the pair $(\tilde{\nabla},\tilde{\nabla}_T)$ are discussed, as well as the corresponding structural equations. The existence of a distinguished spatial tensor analysis over (M,Γ) is finally established, and the resulting mathematical structure is examined in detail. (auth)

9897 SPIN AND TORSION IN GENERAL RELATIVITY. II. Geometry and Field Equations. Hehl, F. W. (Technische Univ., Clausthal, Ger.). Gen. Relativity Gravitation; 5: No. 5, 491-516 (Oct 1974).

In this series of articles the consequences for GR in the framework of a consistent formalism are discussed. There emerges a theory describing in a unified way gravitation and a very weak spin–spin contact interaction. In Part I of this work (Hehl. Gen. Grav.; 4: 333 (1973)) the foundations of the theory were discussed. In this Part the geometrical apparatus necessary for the formulation of the theory is presented. The curvature scalar (or rather its density) is taken as Lagrangian density of the field and in this way the field equations are obtained in their explicit form. In particular it turns out that torsion is essentially proportional to spin. The angular momentum and the energy–momentum theorems are then derived, the latter yields a force proportional to curvature, acting on any matter with spin. The theory so far developed is compared with GR. Torsion leads to a universal spin–spin contact interaction which is, however, proportional to the gravitational constant and therefore very weak. These results are valid for both tensor and spinor matter. Finally it is pointed out that the electromagnetic field does not produce torsion. (auth)

9898 SPATIALLY INTEGRABLE SPACE–TIMES. Whiston, G. S. (Univ. of Durham, Eng.). Gen. Relativity Gravitation; 5: No. 5, 517-524(Oct 1974).

The topological and geometrical restrictions on spatially integrable space–time foliated by space-like hypersurfaces are investigated. (auth)

9899 TOPICS ON SPACE–TIME GEOMETRY. Whiston, G. S. (Univ. of Durham, Eng.). Gen. Relativity Gravitation; 5: No. 5, 525-537(Oct 1974).

Several topics in the geometry of space–times are discussed, including the time and space distributions of the space–time and a geometrical definition of singularities. (auth)

9900 NONGEODESIC MOTION IN GENERAL RELATIVITY. Barker, B. M.; O'Connell, R. F. (Louisiana State Univ., Baton Rouge). Gen. Relativity Gravitation; 5: No. 5, 539-554(Oct 1974).

The equations of motion of a spinning body in the gravitational field of a much larger mass are found using both the Corinaldesi–Papapetrou (Proc. Roy. Soc.; A209: 259 (1951)) spin supplementary condition (SSC) and the Pirani (Acta. Phys. Polon.; 15: 389 (1956)) SSC. These equations of motion are compared with the author's previous result (Phys. Rev.; D2: 1428 (1970)) derived from Gupta's quantum theory of gravitation. It is found that the spin-dependent terms differ in each of the above three results due to a different location of the center of mass of the spinning body. As expected, these terms are not affected by the choice of either Schwarzschild or isotropic coordinates. Finally, for the presently planned Stanford gyroscope experiment, the maximum secular displacement of the orbit of the gyro is found with respect to the orbit of its nonrotating housing to be of the order of (10^{-7} cm/year)t, a result much smaller than Schiff's result (In Honor of Philip M. Morse (Cambridge, Mass.) Chap 13. (1969)) which is proportional to time squared. (auth)

9901 FUNDAMENTAL ELECTRODYNAMICS AND ASTROPHYSICS. Byrne, J. C.; Burman, R. R. (Western Australian Univ., Nedlands). Nature (London); 253: No. 5486, 27(3 Jan 1975).

A discussion is presented on electrodynamic theories which although indistinguishable on laboratory and terrestrial scales from Maxwell's theory may have significantly different consequences for phenomena on an astronomical scale. An example of electromagnetic equations discussed that might be relevant to the description of astrophysical phenomena are the Proca equations, which may be interpreted in terms of a nonzero photon rest mass. (UK)

9902 NUCLEOSYNTHESIS AND MATTER–ANTIMATTER COSMOLOGIES. Combes, F.; Fassi-Fehri, O.; Leroy, B. (Observatoire de Paris, Section de Meudon, France). Nature (London); 253: No. 5486, 25-26(3 Jan 1975).

A discussion is presented on difficulties encountered in fitting abundances of light elements into existing models of symmetric matter–antimatter cosmologies. The basis of these difficulties is in the annihilation process itself. Specific reference is made to D and He abundances. (UK)

9903 CHARACTERISTIC INITIAL VALUE PROBLEM FOR THE DEVELOPMENT OF A KERR SOLUTION. Chellone, D. S. (Univ. of Sheffield, Eng.). J. Phys., A (London); 8: No. 1, 1-5 (Jan 1975).

Some conditions on the characteristic initial data necessary for a solution of Einstein's equations given by a Bondi–Sachs metric (Bondi et al. Proc. R. Soc.; A269: 21-52 (1962) and Sachs. Proc. R. Soc.; A270: 103-26 (1962)) to develop into a Kerr solution are determined. A special case is exhibited where some data specified on the initial null hypersurface, together with the news functions, determines the parameter values for the resulting Kerr solution. (auth)

9904 SCHROEDINGER EQUATION IN GENERAL RELATIVITY. Wospakrik, H. J. (Bandung Inst. of Tech., Indonesia). Proc., Inst. Teknol. Bandung; 8: No. 2, 41-51(1974).

A Schrödinger equation in GR for a charged particle in Coulomb potential is presented, derived from the formulation of the Klein-Gordon equation in GR with an assumption that the kinetic and potential energy are small in comparison with the rest energy mc^2. The term Newtonian potential appeared directly as expected from the nonrelativistic Schrödinger equation in the Newtonian gravitational field. It is shown that its radial equation possesses a nonessential singular point at $r = 0$, therefore, it has a power series solution about $r = 0$. Perturbation theory is used to find its approximation solution. Some divergences remain unsolved. (auth)

9905 NEUTRINO ENERGY-MOMENTUM TENSOR AND THE WEYL EQUATIONS IN CURVED SPACE–TIME. Anderson, I. M. (Univ. of Waterloo, Ont.). Gen. Relativity Gravitation; 5: No. 6, 621-642(Dec 1974).

In general, a first order Lagrangian gives rise to second order Euler–Lagrange equations. However, there are important examples where the associated Euler–Lagrange equations are of first order only, the Weyl neutrino equations being of this type. In this paper first order spinor Lagrangians which give rise to first order Euler–Lagrange equations are therefore considered. Specifically, the most general first order spinor field equations of rank one in curved space-time which are derivable from a first order Lagrangian of the same type are explicitly constructed. Subject to a certain restriction, the Weyl neutrino equation is the only possibility. Furthermore, if the spinor field satisfies the Weyl neutrino equation, then the associated energy momentum tensor is the conventional neutrino energy–momentum tensor. (auth)

9906 QUANTUM THEORY OF GRAVITATION. Ashtekar, A.; Geroch, R. (Univ. of Chicago). Rep. Progr. Phys.; 37: No. 10, 1211-1256(1974).

Attempts to obtain a quantum theory of gravitation are reviewed. The essential ideas of those programs on which extensive work has been done are discussed. Successes and difficulties of each of these programs are described. The attempts are divided into two broad classes: those based on the techniques of canonical quantization and those based on the techniques of quantum field theory. The approach is rather geometrical, an approach which facilitates the comparison of various programs. (auth)

9907 NOTE ON THE MOTION OF BLACK HOLES. Demianski, M.; Grishchuk, L. P. (Univ., Warsaw). Gen. Relativity Gravitation; 5: No. 6, 673-679(Dec 1974).

It is shown that from the point of view of a distant observer the gravitational field of a moving Schwarzschild black hole is the same as produced by an extended, nonrotating, spherical body of the same mass. According to him, a black hole follows the Newtonian equations of motion, though some quantities, for example the distance, lose their Newtonian meaning. (auth)

9908 CONSTRUCTION AND PROPERTIES OF SPACE–TIME B-BOUNDARIES. Friedrich, H. (Univ., Hamburg). Gen. Relativity Gravitation; 5: No. 6, 681-697(Dec 1974).

A criterion is given for two curves of finite generalized affine length to define the same point of the b-boundary of a space-time. It is shown that the b-boundary can be constructed on every closed subbundle of the bundle of linear frames to which the Levi–Civita connection is reducible. It follows that, for any product space–time, the space–time together with its b-boundary is homeomorphic to a product of pseudo-Riemannian spaces with b-boundary. Furthermore, it is shown that maps of one space–time in to another which are isomorphisms of the connections can be C^0-extended to the space–time with b-boundary. In particular, it follows that the group of affine transformations and the group of isometries of a space–time act as topological transformation groups on the space–time with b-boundary. (auth)

9909 CLASSICAL SOLUTION OF THE TWO-BODY PROBLEM IF THE GRAVITATIONAL CONSTANT DIMINISHES INVERSELY WITH THE AGE OF THE UNIVERSE. Vinti, J. P. (Massachusetts Inst. of Tech., Cambridge). Mon. Notic. Roy. Astron. Soc.; 169: No. 3, 417-427(Dec 1974).

Dirac's 1938 suggestion that G varies inversely with the age t of the Universe is first modified to $G = A(k + t)^{-1}$. Here A and k are to be universal constants, k being inserted to avoid infinites in the resulting exact classical solution for the orbit in the two-body problem. In the solar system variations in the two masses are negligible compared to that postulated in G if $k + t \approx 10^{10}$ yr. Applications to the solar system give $(k + t)^{-1}$ for the fractional rate of change of the osculating semi-latus rectum and $-2(k + t)^{-1} n_{osc}$ for the secular acceleration of the osculating mean longitude, n_{osc} being the osculating mean motion. With Van Flandern's value for this acceleration for the Moon, $k + t = (1.08)10^{10}$ yr is found as the age of the Universe. The

verification of such results may become fully possible only after another decade of atomic time will have permitted measurement of planetary orbits freed from the possible impurities of ephemeris time. (auth)

9910 HADRONIC NATURE OF THE EARLY UNIVERSE. Alexanian, M.; Mejía-Lira, F. (Centro de Investigacion y de Estudios Avanzados del Instituto Politecnico Nacional, Departamento de fisica, Apartado Postal 14-740, México 14, D.F.). Phys. Rev. D 11: No. 4, 716-721 (15 Feb 1975).

A model for particle structure is used to describe the "hadron era" of a charge-symmetric model for the early universe. A value of $s \gtrsim 10^7 k$ is obtained at $t \sim 10^{-7}$ sec for the fundamental quantity s, the entropy per baryon. This value for s/k is directly related to the magic number of cosmology 10^{40}. (auth)

9911 FINE-STRUCTURE CONSTANT AND ENTROPY IN THE EARLY UNIVERSE. Alexanian, M. (Centro de Investigacion y de Estudios Avanzados del Instituto Politecnico Nacional, Departamento de Fisica, Apartado Postal 14-740, México 14, D.F.). Phys. Rev. D 11: No. 4, 722-723 (15 Feb 1975).

A recent charge-symmetric model of the very early stages of a big-bang cosmology is used to derive a value for the fine-structure constant. (auth)

9912 THE KINETIC EQUATION IN GENERAL RELATIVITY. Vereshkov, G.M.; Grishkan, Yu.S. (Rostov-on-Don University). Sov. Astron.—AJ 18: No. 5, 660-661 (Mar 1975).

The kinetic equation for a system of gravitating particles is obtained in the post-Newtonian approximation with no further relativistic postulates. Post-Newtonian criteria are thereby devised for a general-convariance formulation. The equation obtained here agrees with Chernikov's equation. (auth)

9913 WHERE IS THE "HIDDEN" MASS?. Ozernoi, L.M. (Lebedev Physics Institute, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 5, 654-656 (Mar 1975).

The ratio of the virial mass to the observed mass in systems of galaxies tend to increase monotonically as the system size (or population) increases from a pair to a cluster. Galaxies may therefore be excluded as the principal source of the missing mass required to stabilize systems. If this hidden mass does exist, it should be located primarily outside the galaxies, in intergalactic space within a system. (auth)

9914 SPATIALLY INHOMOGENEOUS HYDRODYNAMIC MOTION IN ANISOTROPIC COSMOLOGY. Moroz, B.Z.; Chernin, A.D. (P. P. Shirshov Institute of Oceanology, Leningrad Branch, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 5, 561-563 (Mar 1975).

Solutions of the relativistic equations of hydrodynamics for spatially inhomogeneous motions of matter during the vacuum phase of an anisotropic cosmological expansion are derived and analyzed. Unlike solutions for which the space derivatives may be neglected, the motions considered here imply an increase toward epochs in the past of the ratio $\kappa T_k^{i/i-2}$, which describes the relative influence of matter on the behavior of the metric. Hence these solutions do not asymptotically fit the general vacuum solution of Lifshits et al.[1,2] near the singularity. A brief discussion is given of the properties of an anisotropic solution containing four arbitrary functions wherein matter and its motion, rather than the vacuum field, govern the character of the primodial singularity. (auth)

9915 PRIMORDIAL RADIATION IN A HOMOGENEOUS BUT ANISOTROPIC UNIVERSE. Doroshkevich, A.G.; Lukash, V.N.; Novikov, I.D. (Institute of Applied Mathematics, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 5, 554-560 (Mar 1975).

The problem of large-scale anisotropy in the primordial background radiation in a homogeneous, anisotropic universe is investigated. If the density of matter at the present epoch is of the order of the critical density ($\Omega = \rho/\rho_{cr} \simeq 1$), then an anisotropic behavior of the expansion near the singularity would lead to a quadrupole angular dependence of the background anisotropy [Eq.(8)]. If $\Omega < 1$, the anisotropy in the primordial radiation would have the appearance of a "spot" of angular size $\Delta\theta \cong 4\Omega$ [Eqs. (25)]. With the most general assumptions as to the character of the cosmological expansion, the amplitude of the background anisotropy is given by Eqs. (7) and (8), and would be compatible with the observations ($\Delta T/T \lesssim 10^{-3}$) only in the event (the universe is considered to have been transparent since the epoch of hydrogen recombination) that the universe has expanded practically isotropically beginning at the Planck time itself, the epoch $t = 10^{-43}$sec (Tables 1 and 2). The small value of the fluctuations in the temperature of the primordial radiation indicates that the universe is homogeneous to a high degree, which is consistent only with a very slight initial inhomogeneity. On the other hand, the characteristic scale of the perturbation in the primordial background associated with density inhomogeneities on galactic scales is of the order of minutes of an arc. Hence the predicted large-scale background anisotropy would not be smoothed out by the irregularities connected with galaxy formation, and it ought to be observable in the real universe if the cosmological expansion was anisotropic at the beginning. (auth)

9916 ON THE ORIGIN OF THE MICROWAVE BACKGROUND. Hoyle, F. (Kitt Peak National Observatory). Astrophys. J. 196: No. 3, 661-670 (15 Mar 1975).

The background of microwave radiation is known to be remarkably uniform over the sky, although the regions giving rise to the radiation in widely separated elements of solid angle have, according to the usual cosmological theories, always been out of communication with each other. Using a new approach to the big-bang cosmologies, an explanation of this uniformity is given. The intensity of the background appears to be related to the energy of conversion of hydrogen to helium within galaxies. Yet this circumstance is regarded as coincidental in the usual theories. Here it receives explanation. (auth)

9917 APPARENT MAGNITUDES, REDSHIFTS, AND INHOMOGENEITIES IN THE UNIVERSE. Roeder, R.C. (Scarborough College and David Dunlap Observatory, University of Toronto). Astrophys. J. 196: No. 3, 671-673 (15 Mar 1975).

The apparent magnitude-redshift data of Sandage and Hardy have been analyzed using inhomogeneous zero-shear models of the universe and treating both the acceleration factor and the amount of intergalactic material as parameters to be determined by the data. The value found for the acceleration factor depends on the homogeneity factor and on the evolutionary correction assumed for the absolute magnitudes of galaxies, but may possibly be greater than 0.5, in which case the universe is "closed." (auth)

9918 SOME COSMOLOGICAL CONSEQUENCES OF IMAGINARY MASS. Davies, P. C. W. (Univ. of London). Nuovo Cim.; 25B: No. 2, 571-580(11 Feb 1975).

General considerations require that, if imaginary-mass matter can exist, then it will be present and coupled to the thermal gravitons in the early stages of the expansion of the Universe. This imaginary-mass component disappears abruptly as the expansion proceeds, a circumstance of great importance for the dynamics of the Universe. Estimates are given which indicate that this event would have occurred before the end of the hadron era. (auth)

Planetary Phenomena

Refer also to abstracts 9805 and 9960.

9919 (CSNSM-TS-75-1) STUDY OF THE SPACE-LUNAR SURFACE INTERACTIONS. Langevin, Yves. (Centre National de la Recherche Scientifique, 91 - Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse; Paris-7 Univ., 75 (France)). 1975. 96p. (In French). INIS.

This work is an attempt to describe the interactions between space and lunar surface. These interactions, namely meteoritic impact, solar wind effects and the effects of other fluxes of very low energy, the lunar winds depend strongly on depth. In order to determine these effects in the lunar dust grains, the depth history of such grains was first described. Therefore, the trajectories of individual dust grains in the regolith have been simulated by means of a Monte Carlo computation. The results of this program have then been compared with experimental observations of several effects due to space medium: irradiation tracks, formed by the heavy ions of the solar cosmic rays, physical and chemical effects of solar wind, effects of "lunar winds." Experimental results and theoretical predictions agree in such a way that the program seems to describe rather satisfactorily the dynamical evolution of the regolith. This result strongly backs the theory that meteorite flux is the main agent triggering transport mechanism off the lunar surface. After a thorough verification of the most questionable hypothesis, the program will be extended to any planetoid lacking both a strong magnetic field and a thick atmosphere (asteroids, and major planets satellites). (FR)

9920 DIFFERENTIAL SPECTRA AND PHASE SPACE DENSITIES OF TRAPPED ELECTRONS AT JUPITER. McIlwain, C.E.; Fillius, R.W. (Physics Department, University of California at San Diego, La Jolla, California 92037). J. Geophys. Res. 80: No. 10, 1341-1345 (1 Apr 1975).

Using Pioneer 10 data, we have constructed differential spectra and phase space densities of trapped electrons at Jupiter. These quantities should assist in calculating synchrotron radiation from these particles and in evaluating the diffusion mechanisms that accelerate the particles. Absorption by the moons Io and Europa is evident, and injection by Io is demonstrated by a density peak in phase space, which demands a local source. There is also a rapid decrease in density between the

moons, which could call for either a local loss mechanism or nonlocal losses fed by diffusion. (auth)

9921 SECOND LOOK AT JUPITER. Burgess, E. (National Aeronautics and Space Administration, Moffett Field, CA). New Sci.; 64: No. 927, 804-806(12 Dec 1974).

The latest flyby of Jupiter by Pioneer 11 confirmed many of the results of Pioneer 10's encounter with Jupiter a year before but also produced some surprises about the Jovian environment. Many of these discoveries are described. Bursts of energetic protons were recorded in addition to the bursts of energetic electrons already found by Pioneer 10. Pioneer 11 also found that there is a greater flux of energetic particles at high Jovian latitudes than would have been expected from a simple extrapolation of the Pioneer 10 results. A picture of Jupiter emerges with an enormous spinning magnetosphere continually stirred and mixed by the Galilean satellites. Refined figures obtained for the densities of the Galilean satellites are given. Many characteristics detected by Pioneer 10 and now confirmed by Pioneer 11 are discussed. (UK)

9922 EFFECT OF ELECTRONS ON EXOEMISSION PROPERTIES OF LUNAR MATERIAL. Mints, R. I.; Mil'man, I. I.; Kryuk, V. I. Fiz. Khim. Obrab. Mater.; No. 5, 124-128(1974). (In Russian).

Results are given of studies on the exoemission of particles of lunar soil, from "Lunar-16" and "Lunar-20" samples, after surface activation with slow (6-keV) electrons. There was a difference in the exoemission activity of marine and continental regolith due to specific features of their formation and residence on the lunar surface. (TTT)

9923 THERMAL METAMORPHISM OF PRIMITIVE METEORITES. I. Variation of Six Trace Elements in Allende Carbonaceous Chondrite Heated at 400 to 1000°C. Ikramuddin, M.; Lipschutz, M. E. (Purdue Univ., Lafayette, IN). Geochim. Cosmochim. Acta; 39: No. 3, 363-375(Mar 1975).

Determination by neutron activation of 6 trace elements retained in Allende (C3) samples heated at 400 to 1000°C for 1 week in a low-pressure (initially $\sim 10^{-5}$ atm H_2) atmosphere reveals loss of small proportions of Ga and Se and large proportions of Bi, In, and Tl–Co being unaffected. The retentivity patterns for the 5 volatile elements differ and in no way duplicate a step-function. In contrast to these trace elements, sulfur is initially present in discrete mineral(s) and visually it appears to be released over a narrow temperature range. Elements are lost more easily from powder than from chips but the difference is ≤ 35 per cent. Above 600°C, the process of loss appears due to process(es) with apparent activation energies of 2 kcal/mole (Bi, Tl), 4 kcal/mole (Se) and 22 kcal/mole (In). Loss of Bi, Se, and Tl below 600°C involves higher apparent activation energies. Two-element correlation diagrams involving Bi, In, and Tl are consistent with the idea that trends among highly-volatile elements in enstatite chondrites arise from metamorphism. (auth)

9924 He, Ne, AND Ar ISOTOPES IN INCLUSIONS OF SOME IRON METEORITES. Levskii, L. K. (All-Union Geological Inst., Leningrad); Komarov, A. N. Geochim. Cosmochim. Acta; 39: No. 3, 275-284(Mar 1975).

^{3}He, ^{4}He, ^{21}Ne, and ^{38}Ar contents were determined in 18 metal, troilite, schreibersite, and graphite inclusions of 9 iron meteorites, by total outgassing and stepwise heating. The ^{4}He/^{3}He ratio in metal phase ranges from 3.85 to 4.65, but in nonmetallic samples, from 6.70 to 30.5. The results for cosmogenic isotopes of helium, neon, and argon disagree appreciably with data on accelerator-irradiated targets. Is should be noted, however, that some inclusions have lost considerable amounts of gas by diffusion. Uranium contents of 22 troilite and schreibersite samples were determined by the fission track technique. The average uranium content of troilite is 0.4 to 0.7 ppb. Excess ^{4}He of unknown origin was observed in troilite inclusions. If it is assumed that the excess of ^{4}He was produced by uranium decay in situ, then the apparent U–^{4}He age is at least 5.9×10^9 yr. (auth)

9925 METEORITIC TRACE ELEMENTS IN LUNAR ROCK 14321, 184. Morgan, J. W.; Ganapathy, R.; Krahenbuhl, U. (Univ. of Chicago). Geochim. Cosmochim. Acta; 39: No. 3, 261-264 (Mar 1975).

The 16 trace elements (Ag, Au, Bi, Br, Cd, Cs, Ge, In, Ir, Rb, Re, Sb, Se, Te, Tl, and Zn) were measured by radiochemical neutron activation analysis in six samples of 14321, 184: microbreccia-2 (15), microbreccia-3 (14A, 16A and 19A), basaltic clast (1A), and light matrix material (9A). The 14321 microbreccias typically contain a siderophilerich ancient meteoritic component, poor in volatiles, which is characterized by low Ir/Au and Re/Au ratios (0.25 to 0.38 and 0.34 to 0.50, respectively, normalized to Cl). This component also occurs in Apollo 12 KREEP glasses, norite fractions of Apollo 14 1 to 2 mm soils, Apennine Front breccias, and Cayley Formation material, and may represent ejecta from the Imbrian basin. The basaltic clast 14321, 184-1A closely resembles 14053 in trace element content, and both are 5 to 10 times higher than mare basalts in volatile trace elements (Br, Cd, Tl). The light matrix material contains 9.2 ± 0.5 per cent of microbreccias, judging from its siderophile content. (auth)

9926 TV OBSERVATIONS OF MARS DURING THE 1969 OPPOSITION. Prokof'eva, V. V.; Ushakova, N. A.; Abramenko, A. N.; Dabakhov, A. K. Izv. Krym. Astrofiz. Observ.; 47: 139-152(1973). (In Russian).

During the summer of 1969 in the Crimean Astrophysical Observatory on the 50-cm meniscus telescope, about 5000 television pictures of Mars were obtained in the ultraviolet, blue, green, and red regions of the spectrum. The brightest clouds, which have a brightness maximum in the short wavelength region of the spectrum, were encountered at almost all latitudes of the planet in the period from May 26 to June 6. In the course of the following period from June 10 to July 1 the Martian atmosphere in blue and ultraviolet rays appeared to be cleaner. During this time, a total of three blue pictures of the clear planet were taken, one of which was a global picture. Starting from June 20 over a period of almost two weeks at the eastern edge of the disk in the region of the equatorial and median south latitudes, a large white cloud was observed. Twice the presence of yellow clouds was noted. In the period from July 6 to August 5, clouds and fogs were observed over the polar regions. The equitorial region and the region of the median latitudes were clear during this period. Photometry of the pictures of Martian cloud formations showed that the brightness maximum of the clouds can occur at any wavelength in the spectral range that was used. While photographing on board "Mariner-6" and "Mariner-7" in the region of the north and south polar regions, observations were made of the cloud formations which had a maximum brightness in the ultraviolet region of the spectrum and also were readily noticeable on pictures taken with blue and green filters. (SJR)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 9028, 9784, and 9977.

9927 (AD-783541) IONOSONDE UNDERLYING IONIZATION CORRECTION USING IONOSPHERIC MODELS. Ferriola, D. F. (Pennsylvania State Univ., University Park (USA). Ionosphere Research Lab.). 3 Jul 1974. Contract N00014-67-A-0385-0017. 48p. (PSU-IRL-SCI-425E). NTIS $5.50.

Ionogram reduction has been hampered for many years by the lack of a virtual height trace at the lower frequencies of the ionogram. The missing lower trace contains information concerning the ionization in the E and F1 region, which is needed to accurately convert the virtual height and frequency profile into a real height and electron-density profile. A method to account for this underlying ionization using ionospheric models is presented and the results compared with other sounding techniques. (auth)

9928 (AD-784897) ELECTRON IMPACT EXCITATION OF N_2, O_2, AND O AND UPPER ATMOSPHERIC DIAGNOSTICS WITH ELECTRON BEAM FLUORESCENCE PROBES. Haasz, A. A. (Toronto Univ., Ontario (Canada). Inst. for Aerospace Studies). Oct 1973. 198p. (UTIAS-194; AFOSR-TR-74-1431). NTIS $5.50.

Characteristic emission spectra in the 2000 to 6000A wavelength range, induced by 0.6 to 3 keV energy electrons, were obtained for molecular nitrogen, molecular oxygen, and atomic oxygen. To study the atomic oxygen fluorescence, ground state O atoms were produced in the absence of O_2 molecules by the N + NO to N_2 + O titration reaction. Absolute excitation cross sections were obtained for some of the prominent spectral features of N_2, O_2, and O; the emissions were selected on the basis of their applicability for upper atmospheric diagnostics with electron beam fluorescence probes. In parallel with the laboratory investigations of the electron beam induced fluorescence in atmospheric gases, an electron beam fluorescence probe (EBFP) has been developed for rocket flight applications in the 80 to 150 km altitude range. The EBFP is capable of measuring vibrational and rotational temperatures as well as species concentrations in the upper atmosphere. The instrument employs a 2.5 keV, 4 mA electron beam to induce fluorescence in the ambient gas of the atmosphere. (GRA)

9929 (AD-785110) CALCULATION OF THE ABSORPTION OF X-RAY RADIATION IN THE EARTH'S ATMOSPHERE. Kuzmin, I. A.; Lazutin, L. L.; Khlebnikova, L. A. 22 Aug 1974. Translated by C. M. Barber from pp 156-176 of Kompleksnye Issledovaniya Polyarnoi Ionosfery, 1970. (FTD-MT-24-1980-74). 26p. NTIS $3.25.

Measuring bremsstrahlung in the stratosphere is one of the methods of studying the electron flows responsible for the majority of geomagnetic disturbances at high latitudes. However, the interpretation of stratospheric measurements involves a number of difficulties which appear when scaling the recorded x-ray radiation to an electron flow. The scaling procedure in accordance with the physical sense of the process consists of two stages: (1) calculation of the initial flow and spectrum of photons at the generation level with respect to the flow at the detection level; (2) calculation of electron flow with respect to the flow of bremsstrahlung photons. In the present work the authors examined the first stages, i.e., calculation of the passage of x-ray radiation through the upper layers of the atmosphere. (GRA)

9930 (AD-785841) NUMERICAL MODEL OF THE MID-LATITUDE IONOSPHERE. Oran, E. S.; Coffey, T. P.; Strobel, D. F.; Young, T. R. Jr.; Anderson, D. V. (Naval Research Lab., Washington, D. C. (USA)). Jul 1974. 97p. (NRL-MR-2839). NTIS $4.75.

A description of the theoretical one-dimensional laminar model of the mid-latitude ionosphere developed at NRL is presented. The physics, chemistry, and approximations that go into the model are described in detail. Radiation deposition and the applicable chemical reactions are discussed, and the multi-fluid equations governing velocities, temperatures, and densities in the ionosphere are reduced to a tractable one-dimensional set of equations with vertical variations. Numerical techniques used in solving the resulting coupled equations are outlined. Finally, preliminary results and future work on model are discussed. (auth)

9931 (AD-787782) ANALYSIS OF SATELLITE RECORDINGS. Fine Structure Variations of Total Electron Content. Interim Scientific Report, 1 July 1973–30 June 1974. Hughes, K. A.; Kersley, L. (University Coll. of Wales, Aberystwyth (UK). Dept. of Physics). 31 Aug 1974. 64p. (AFCRL-TR-74-0471). NTIS $4.25.

Fine structure variations of total electron content of a quasi periodic nature were analyzed for the period June 1971 to April 1973. The observations are interpreted as ionospheric manifestations of internal gravity waves in the neutral atmosphere. A statistical connection is shown between ionospheric perturbations of a periodic nature and developing cyclonic systems in the troposphere which appear to act as source regions for internal gravity waves. (GRA)

9932 (AD-787785) ION MASS SPECTROMETRY OF THE LOWER IONOSPHERE. Final Scientific Report, 1 May 1967–31 Dec 1971. Boyd, R. L. F.; Dorling, E. B.; Norman, K.; Woolliscroft, L. J. C. (University Coll., London (UK). Mullard Space Science Lab.). 15 Feb 1974. Contract F6105-67-C-0078. 91p. (MSSL-205; AFCRL-TR-74-0503). NTIS $4.75.

A short pathlength radio frequency ion mass spectrometer was developed for rocket measurements in the d and lower e regions of the ionosphere without the interposition of a shock between plasma and spectrometer. Design and operation are discussed. Ions of mass 16 ± 1, 18 ± 1, 21 ± 2, 28 ± 2, 36 ± 3, and 55 ± 5 were detected on the ascent and descent between 90 (+) and 120 km. The tentative ion identifications are O (+), H_3O (+), Na (+), or Mg (+), NO (+), K (+), and Fe (+). (GRA)

9933 (AD/A-001817) RESEARCH IN RADIATION PHYSICS AND AERODYNAMICS. Semiannual Technical Status Report, 1 October 1973–31 March 1974. Lin, S. C. (California Univ., La Jolla, San Diego (USA). Inst. of Pure and Applied Physical Sciences). 31 Mar 1974. Contract DAHC04-72-C-0037. 26p. (ARO-10757.61-P). NTIS. $3.75.

Contents of the report include: highlights of recent accomplishments; report of progress in brief–laser physics, optics and atmospheric propagation, high-temperature entrainment and metal oxide emissivity, plume physics and radiation, stratified flow and ocean physics, ionospheric physics, and plasma interactions. (GRA)

9934 (COM-74-50087-360) IONOSPHERIC DATA. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Aug 1974. 132p. (NOAA-FA-360). National Climatic Center, Asheville, NC 28801 $1.00.

The publication contains monthly medians for the same month the publication is issued. For example, the January 1973 issue includes all the data available for January 1973 and any previous unpublished data for January from earlier years. Also published are detailed data for the same month from an exemplary station, Wallops Island (Washington) including daily-hourly values of all characteristics, F-plots for regular world days, and an N(H) contour graph. As timely information, there is included selected ionospheric data for a retrospective world interval, when appropriate. Also given is information on ionospheric data recently received at World Data Center A for solar-terrestrial physics and other information on availability of data from the WDC's. This issue also contains tables and graphs of monthly median ionospheric data for August 1957 and each August to that of 1973. (GRA)

9935 (COM-74-50276-33) AURORAL ELECTROJET MAGNETIC ACTIVITY INDICES AE (10) FOR 1967. Allen, J. H.; Abston, C. C.; Morris, L. D. (World Data Center A for Solar-Terrestrial Physics, Boulder, Colo. (USA)). May 1974. 148p. (UAG-33). National Climatic Center, Asheville, NC 28801 $0.75.

The auroral electrojet index (AE) is discussed and a brief description is given of the derivation of 10-station 2.5-min AE indices for 1967. Tables are given of hourly average indices for each day of the year, of the stations making the main contribution to the hourly indices, and of the average monthly quiet-time level of horizontal fields (H) at each magnetic observatory. Graphs of the index variations are included for each day of 1967. (GRA)

9936 CERTAIN RESULTS OF INVESTIGATIONS OF NONLINEAR EFFECTS IN THE E LAYER OF THE IONOSPHERE. Shlyuger, I. S. JETP Lett.; 20: No. 11, 334-336(5 Dec 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 11, 722-726(5 Dec 1974).

Defects of strong self-action of a high-power radio pulse and of deep cross modulation of trial waves in the lower layers of the ionosphere are described. (auth)

9937 MECHANISM OF EXCITATION OF COMBINATION FREQUENCIES IN IONOSPHERIC PLASMA. Kotik, D.S.;

Trakhtengerts, V.Yu. (Radiophysics Physics Research Institute). JETP Lett. 21: No. 2, 51-52 (20 Jan 1975).

We consider the mechanism whereby combination frequencies are excited in an ionospheric plasma acted upon by powerful short-wave radiation. The results are compared with experiment. (auth)

9938 ELECTRON DENSITY DECREASE IN SAR ARCS RESULTING FROM VIBRATIONALLY EXCITED NITROGEN. Newton, G.P. (Laboratory for Planetary Atmospheres, Goddard Space Flight Center, Greenbelt, Maryland 20771); Walker, J.C.G. J. Geophys. Res. 80: No. 10, 1325-1327 (1 Apr 1975).

Enhanced vibration of molecular nitrogen is produced in SAR arcs by collisions with hot thermal electrons. The rate coefficient for the reaction between oxygen ions and molecular nitrogen is increased as a result of the vibrational excitation, and this leads to an increase in the rate of loss of *F* region ionization. By solving the *F* region continuity equation for conditions appropriate to SAR arcs both with and without allowance for the effects of vibrational excitation we show that vibrational excitation may be the cause of the *F* region electron density depression that is observed in SAR arcs. Our solutions also show than the observed depression cannot be caused by redistribution of ionization due to enhanced electron temperatures alone. (auth)

9939 MEASUREMENTS OF Pc 5 IONOSPHERIC ELECTRIC FIELDS BY MEANS OF BALLOON-BORNE SENSORS. D'Angelo, N.; Iversen, I.B.; Madsen, M.M. (Danish Space Research Institute, Lyngby, Denmark). J. Geophys. Res. 80: No. 10, 1352-1353 (1 Apr 1975).

Measurements of ionospheric pulsating electric fields by means of balloon-borne sensors are reported. The electric field pulsates with a period of ~6 min and is apparently associated with a Pc 5 micropulsation. The relevance of the present observations to the association, reported in the literature, between pulsating auroral radar echoes and geomagnetic micropulsations in the Pc 5 range is discussed. (auth)

9940 ON THE IMPORTANCE OF DOUBLY CHARGED IONS IN THE AURORAL IONOSPHERE. Prasad, S.S.; Furman, D.R. (Department of Physics and Astronomy, University of Florida, Gainesville, Florida 32611). J. Geophys. Res. 80: No. 10, 1360-1362 (1 Apr 1975).

Consideration has been given to the auroral ionospheric O^+ density dilemma as discussed by Donahue et al. (1970). If the temperature dependences of the reactions $O^+ + O_2 \rightarrow O_2^+ + O$ and $O^+ + N_2 \rightarrow NO^+ + N$ are of the type found by Stubbe (1969) and Johnsen and Biondi (1973), the line of explanation invoking intense electric fields and high ion temperature faces serious trouble. This would make the O^+ density problem all the more pathological. However, a simple explanation was possible in terms of O_2^{++} and N_2^{++} ion chemistry. The beauty of this explanation lay in the fact that neither high temperatures nor electric fields need be invoked. Physicochemical problems connected with the new explanation are discussed, and it is suggested that the properties of the doubly charged ions deserve a closer study in the laboratory. (auth)

9941 LATITUDE DEPENDENCE OF IONOSPHERE TOTAL ELECTRON CONTENT: OBSERVATIONS DURING SUDDEN COMMENCEMENT STORMS. Lanzerotti, L.J. (Bell Laboratories, Murray Hill, New Jersey 07974); Cogger, L.L.; Mendillo, M. J. Geophys. Res. 80: No. 10, 1287-1306 (1 Apr 1975).

The latitude dependence of the changes in the ionosphere total electron content (TEC) has been studied during 12 magnetic storms. TEC observations were obtained at Hamilton, Massachusetts, and Arecibo, Puerto Rico. Definite latitude differences are observed in the TEC responses during the magnetic storms: both TEC enhancements and TEC depletions are observed at Hamilton, while only enhancements are measured at Arecibo. A pre-local midnight TEC 'ledge' is frequently observed in the Arecibo storm data but is seldom observed in the higher-latitude Hamilton data. These enhanced ledges in the Arecibo TEC, together with the nighttime TEC depletions measured at Hamilton, produce large south-to-north differences in the ionosphere TEC. The ledges at Arecibo may arise from electrodynamic drift effects associated with westward electric fields; the role of the motion term in the continuity equation for the TEC is assessed under these conditions. The local evening enhancements in the TEC during certain large storms are discussed in the context of the latitude dependence of the storm time magnetic field variations measured from Great Whale River to San Juan. It is shown that the large TEC enhancements appear to be associated with large positive geomagnetic bays at middle to high latitudes. (auth)

9942 DYNAMICS AND MECHANISM OF FORMATION OF THE MORNING AURORAL ABSORPTION MAXIMUM. Sergeev, V. A.; Shumilov, O. I. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 381-384(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 452-456(1974).

The eastward spreading of the auroral absorption (AA) region during a substorm was investigated. The characteristic of AA spreading indicates enhanced precipitation of energetic electrons from a trapped-particle cloud drifting in the noon magnetosphere. Enhanced precipitation is produced by an increase in the density of the cold plasma in the morning magnetosphere at L = 5 to 7, so that a large number of energetic particles can participate in resonance interaction with waves, enhancing pitch-angle diffusion in the trapped-electron cloud. (auth)

9943 NIGHTTIME IONIZATION SOURCES IN THE IONOSPHERIC E REGION. Nesterov, V. P. (Inst. of Experimental Meteorology, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 375-380(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 445-451(1974).

The effect of scattered ultraviolet emissions and corpuscular streams in the ionospheric E region is investigated. The conclusion is reached that both corpuscular streams and scattered emissions can equally be the nighttime ionization sources at heights of ~100 km. Some additional source of NO^+ ions must exist at the 120-km level. (auth)

9944 VERTICAL DISTRIBUTION OF H^+ AND O^+ IONS IN THE IONOSPHERIC F REGION WITH ALLOWANCE FOR THE ENTRAINMENT EFFECT (NUMERICAL EXAMPLE). Ginzburg, E. I.; Kim, V. F. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Translated from Geomagn. Aeron.; 14: No. 3, 441-444(1974).

The influence of the entrainment effect, arising during the diffusion spreading of an ionospheric layer, on the vertical distribution of admixed ions is demonstrated by numerical computations for a specific model of the ionospheric F region. Allowance for this effect during the daytime has resulted in a decrease in the maximum H^+ concentration by more than one order of magnitude. (auth)

9945 STRUCTURE OF THE LARGE-SCALE ELECTRIC FIELD IN THE HIGH-LATITUDE IONOSPHERE. II. Gurevich, A. V.; Krylov, A. L. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 366-370(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 435-440(1974).

Expressions describing the electric field and currents in the polar and auroral zones and their associated magnetic variations are obtained and analyzed. (auth)

9946 EFFECT OF SHIELDING PLATES ON THE CURRENT OF A PLANE PROBE IN A RAREFIED MAGNETIZED PLASMA STREAM. Ponomarev, V. N. Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 360-365(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 428-434(1974).

The problem of the impingement of ions upon a plane probe near protruding plates is solved for the case when the sensing surface of the probe is oriented along a plasma stream drifting along the magnetic field. (auth)

9947 SOME CHARACTERISTICS OF THE NONSTATIONARY CHARGED-PARTICLE DISTRIBUTION IN THE IONOSPHERE. Khantadze, A. G.; Gvelesiani, A. I. (Inst. of Geophysics, Tbilisi, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 355-359(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 423-427(1974).

An exact solution is given of the nonstationary charged-particle diffusion equation for inhomogeneous boundary conditions. (auth)

9948 IONOSPHERIC DISTURBANCE OF NOVEMBER 5–12, 1970. Ben'kova, N. P.; Zevakina, R. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 385-391(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 457-465(1974).

A disturbance produced by a proton flare and by the same active region after the flare crossed the central meridian is investigated. It is demonstrated that the low-energy component of a corpuscular stream is more intense during a proton flare and produces a highly active disturbance. It was found that disturbances in the F region propagate from high to low latitudes not only along the ionosphere, but also along lines of force while the disturbance spreads to lower magnetic shells. They propagate to lower latitudes on the night than the day side. The role of ionospheric currents in the disturbance of the F region is discussed. (auth)

9949 TEMPERATURE VARIATIONS IN THE F_2 REGION IN 1958 AND 1969 DURING MAGNETIC-IONOSPHERIC STORMS WITH A NEGATIVE DEVIATION OF CRITICAL FREQUENCY. Sire, A. Sh.; Agalakov, V. S. Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 405-408(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 481-486(1974).

The temperature variations of the ionosphere at heights h_pF_2 during the magnetic-ionospheric storms of 1958 and 1969 are obtained for mid-latitude stations. A correlation is found between temperature variations and ΣK_p and A_p. The main characteristics of temperature variations for storms with a sudden and gradual commencement are noted. (auth)

9950 SEASONAL ANOMALY IN THE ELECTRON DENSITY OF THE F_2-LAYER MAXIMUM AND OF THE TOPSIDE IONOSPHERE DURING HIGH SOLAR ACTIVITY. Fatkullin, M. N.; Moyenkova, N. M.; Legen'ka, A. D. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 463-465(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 546-548(1974).

The seasonal anomaly extends vertically from 180 to 500 km around noon at middle latitudes during low solar activity. It is also observed only at $h \geq 180$ km in the lower part of the F region at high solar activity. The diurnal and latitudinal development of the seasonal anomaly in the topside ionosphere during high solar activity is examined on the basis of Alouette-1 data. (WDM)

9951 CONTRIBUTION TO THE METHOD FOR DETERMINING THE HORIZONTAL SPEED OF LARGE-SCALE IONOSPHERIC DISTURBANCES. Drobzhev, V. I.; Kudelin, G. M.; Nurgozhin, B. I.; Pelenitsyn, G. M.; Troitskii, B. V. (Ionospheric Sector, Kazan). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 465-466(1974).

Translated from Geomagn. Aeron.; 14: No. 3, (1974).

A method for determining the horizontal speed of large-scale ionospheric disturbances using synthesized artificial fading is considered. (WDM)

9952 POSSIBILITY OF DETERMINING THE MAGNITUDE OF ELECTRON DENSITY FLUCTUATIONS IN THE IONOSPHERE FROM OBLIQUE-BACKSCATTER SOUNDING DATA. Erofeyev, N. M.; Anishchenko, L. P. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 469-470(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 552-553(1974).

To determine the magnitude of the effective fluctuation of electron density along various azimuths from Irkutsk, distance along the ray observations made every minute during OBS sounding of the ionosphere with circular scanning were used. (WDM)

9953 DAYTIME ELECTRON DENSITY PATTERN IN THE UPPER ATMOSPHERE. Murtov, B. A.; Starkova, A. G. (Inst. of Applied Geophysics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 472-474(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 556-557(1974).

The daytime pattern of the electron density (n_e) at middle latitudes ($\varphi = 30$ to 60°N) was investigated on the basis of an analysis of 80 measurements of n_e at a height of 130 km, performed mainly by rockets. (WDM)

9954 MEASUREMENT OF ELECTRON DENSITY IN LOW DENSITY PLASMAS FROM THE ELECTRON ACCELERATING REGION CHARACTERISTICS OF CYLINDRICAL LANGMUIR PROBES. Goodall, C. V.; Polychronopulos, B. (Univ. of Birmingham, Eng.). Planet. Space Sci.; 22: No. 12, 1585-1596(Dec 1974).

Measurements carried out using a cylindrical Langmuir probe operated in the electron accelerating region of the current-voltage characteristics under orbital limited conditions in low density plasmas, show the response of the probe to be in good agreement with Langmuir theory. By making observations in three different plasmas, namely a steady state plasma, an afterglow plasma, and the ionospheric plasma it is confirmed that the form of the orbital limited characteristics of the probe is independent of the energy distribution of the electrons in the plasma. Comparative measurements of ionospheric electron densities made between a rocket borne cylindrical probe and a ground based ionosonde show good agreement to exist and thus demonstrate that the probe operated in this mode not only overcomes the significant problems associated with retarding region probe measurements but affords an accurate determination of electron density. This underlines the usefulness of this kind of probe for electron density measurements in plasmas where the energy distribution of the electrons is unknown. (auth)

9955 CERENKOV RADIATION AND THE FRONT STRUCTURE OF A BEAM INJECTED INTO THE IONOSPHERE. Karpman, V. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Planet. Space Sci.; 22: No. 12, 1597-1610(Dec 1974).

An investigation of the front structure of the beam injected into the ionosphere in conditions corresponding to the "Electron Echo" Experiment (Hendrickson et al., Nature (London); 230: 564 (1971)) is presented. It is shown that the front region of the beam is bunched and the Cerenkov radiation of the bunched beam is investigated. An explanation of the maxima of the amplitudes for definite pitch angles, observed in experiments, is given. (auth)

9956 NEW FORM OF REPRESENTATION OF THE DIURNAL AND SOLAR-CYCLE VARIATIONS OF IONOSPHERIC ABSORPTION. Samuel, J. C.; Bradley, P. A. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys.; 37: No. 1, 131-141(Jan 1975).

The diurnal and solar-cycle variations of vertical-incidence absorption at a fixed frequency are shown to depend on the ratio of wave frequency to f_oE; thus results quoted by different workers are sometimes apparently contradictory, unless a correction is made for the changing f_oE over the measurement period. To represent temporal changes it is proposed that results should be expressed in terms of $\int N\nu\, dh$, the integrated product of electron concentration and collision frequency over the whole of the absorbing region. This can be done using the form of the dependence of absorption on frequency originally established by George for noon. By this means, sample multifrequency measured data are shown to give consistent diurnal and solar-cycle variations. (auth)

9957 POLARISATION OF ATMOSPHERIC BREMSSTRAHLUNG. Rausaria, R. R.; Singh, R. N. (Banaras Hindu Univ., India). Nature (London); 253: No. 5486, 28-29(Jan 1975).

The generation of bremsstrahlung x rays in the atmosphere is first explained, and it is stated that the degree of polarisation of the radiation changes rather drastically with the changing energy of electrons precipitating into the lower ionosphere and with the height of precipitation. No attempts have been made, however, to measure the polarisation of atmospheric bremsstrahlung. The potential importance of bremsstrahlung x-ray polarisation and its role in atmospheric diagnostics are here indicated. A computation is made of the height profile of the polarisation in the terrestrial atmosphere and its variation with related parameters. It seem feasible that measurements of polarisation could be used as a probe for studying precipitating electron energy and flux. (UK)

9958 MEASUREMENTS OF THE NATURAL β-ACTIVITY AND THE ATMOSPHERIC POLAR CONDUCTIVITY IN THE ATMOSPHERIC SURFACE LAYER. Israelsson, S.; Knudsen, E.; Ungethum, E. (Uppsala Univ.). Atmos. Environ.; 9: No. 1, 121-129(Jan 1975).

Like the natural radioactivity, the polar conductivity of the air shows a pronounced diurnal variation; the records show a sharp peak in the early morning and a very flat minimum in the afternoon. The diurnal variation is most pronounced from late spring to early autumn, i.e. it is least during late autumn, in the winter and in early spring when the diurnal variation of the turbulent transfer is small. Consequently, the relationship between natural radioactivity and polar conductivities is slight during this period. From correlation studies a relationship between the natural β-activity and the polar conductivities has been observed in situations with stable stratification. This probably depends on the influence of stability in the low layer upon the variations of the natural atmospheric radioactivity. When applying Fourier analysis to the variations of the polar conductivities greater amplitudes appear for the negative polar conductivity than for the positive polar conductivity. This feature is found for all wave lengths and throughout the year. No explanation is given for these differences. (auth)

9959 INCOHERENT SCATTER MEASUREMENTS OF E- AND UPPER D-REGION IONIZATION CHANGES DURING THREE SOLAR FLARES. Taylor, G. N. (Royal Radar Establishment, Malvern, Eng.). J. Atmos. Terrest. Phys.; 37: No. 2, 349-357 (Feb 1975).

The use of incoherent scatter radar for obeerving sudden ionospheric disturbances is discussed. Measurements of electron densities at heights between 80 and 130 km during three solar flares are presented, and compared with observations of the simultaneous optical, radio, and soft x-ray events. It is not possible to describe the relationship between the magnitudes of the x-ray and ionospheric events uniquely. (auth)

Magnetospheric Phenomena

Refer also to abstracts 9780–9781, 9790, and 9803.

9960 (AD-784429) SPIRAL INTERPLANETARY MAGNETIC FIELD: A POLARITY AND SUNSPOT CYCLE VARIATION. Svalgaard, L.; Wilcox, J. M. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Jun 1974. Contract N00014-67-A-0112-0068. 13p. (SU-IPR-573). NTIS $3.00.

Spacecraft observations near the earth of the yearly average direction of the interplanetary magnetic field during the sunspot maximum year 1968 showed a deviation from the spiral field of E. N. Parker's classical description. The included angle between the average field direction when the field polarity was away from the sun and the average direction for toward polarity was 168 degrees, rather than 180 degrees as predicted by Parker. This effect appears to have a sunspot cycle variation. (auth)

9961 (AD-786477) PRELIMINARY PROTON FLUX DATA OBTAINED ON AIR FORCE SATELLITE 72-1. Holeman, E.; Filz, R. (Emmanuel Coll., Boston, Mass. (USA)). Jun 1974. Contract F19628-73-C-0190. 54p. (AFCRL-TR-74-0325). NTIS $4.25.

This report provides a table of trapped proton directional and omnidirectional fluxes. The fluxes are obtained by summing all available data over the period Oct 1972 to Dec 1973. No corrections are made for instrumental effects or time variations. (auth)

9962 A COMPUTER SIMULATION OF COLD PLASMA EFFECTS ON THE WHISTLER INSTABILITY FOR GEOSTATIONARY ORBIT PLASMA PARAMETERS 2. THE CASE OF ENHANCEMENT OF THE MAXIMUM RATE OF GROWTH. Cuperman, S. (NOAA Environmental Research Laboratories, Boulder, Colorado 80302); Sternlieb, A. J. Geophys. Res. 80: No. 10, 1357-1359 (1 Apr 1975).

Cuperman and Landau (1974) have analytically investigated the modifications of parallel propagating whistler waves in an infinite uniform warm (w) anisotropic plasma in the presence of various amounts of cold (c) plasma. The authors found that the addition of cold plasma increases the instability range in k space and increases (decreases) the maximum rate of growth if $P \equiv \beta A (A+1)^2 < 1 (> 1)$. Here $\beta \equiv 4\pi n_w K T_{\|w} / B^2_0$ and $A \equiv (T_\perp / T_\|)_w - 1$. Cuperman et al. (1973) have performed a computer simulation experiment and confirmed the analytical predictions for the case $P > 1$. This paper presents the results of a computer simulation for the regime $P < 1$. The analysis of the time behavior of the total electromagnetic activity developed confirms the basis analytical predictions for the possible enhancements of the whistler mode instability in the presence of cold plasma. (auth)

9963 MIRROR HEIGHT LOWERING OF TRAPPED ELECTRONS BY AN INDUCTIVE ELECTRIC FIELD. Murphy, C.H.; Wang, C.S.; Kim, J.S. (Department of Atmospheric Science, State University of New York at Albany, Albany, New York 12222). J. Geophys. Res. 80: No. 10, 1346-1348 (1 Apr 1975).

The effect of a ring current inductive electric field on the motion of electrons trapped in the magnetosphere is investigated. The lowering of mirror height of the electrons is of primary concern. The guiding center equations are used to describe the particle motion in a dipole field and an inductive electric field that is produced by a time-dependent symmetric ring current. The equations are solved numerically by means of a fourth-order Runge-Kutta technique. Results of the calculation show that a westward inductive electric field of about 0.6 mV/m can lower the mirror heights of electrons to the auroral height (~100 km) from 200 km in about 290 s. The increase in the collision frequency accompanying such a lowering is 3 orders of magnitude or greater, so that the loss of electrons to the atmosphere should be greatly enhanced. (auth)

9964 OBLIQUE VHF RADAR SPECTRAL STUDIES OF THE EQUATORIAL ELECTROJET. Fejer, B.G.; Farley, D.T. (School of Electrical Engineering, Cornell University, Ithaca, New York 14850); Balsley, B.B.; Woodman, R.F. J. Geophys. Res. 80: No. 10, 1307-1312 (1 Apr 1975).

A new narrow-beam antenna at the Jicamarca Observatory permits oblique (zenith angle, 25°) radar spectral studies of the electrojet with an altitude resolution down to 1.1 km. Only daytime observations are possible presently, however. The general altitude variations in spectral shape observed are consistent with linear instability theory, if the effect of recombination is included. The height at which the mean Doppler shift of the echo maximizes, however, is about 4 km higher than one would expect on the basis of electrojet models. An increase in the assumed collision frequency would remove the discrepancy. Other data presented strongly suggest that at least some of the variations observed in the type 1 echo phase velocity are due to changes in the temperature of the E region. (auth)

9965 VERTICAL STRUCTURE OF THE VHF BACKSCATTERING REGION IN THE EQUATORIAL ELECTROJET AND THE GRADIENT DRIFT INSTABILITY. Fejer, B.G.; Farley, D.T. (School of Electrical Engineering, Cornell University, Ithaca, New York 14850); Balsley, B.B.; Woodman, R.F. J. Geophys. Res. 80: No. 10, 1313-1324 (1 Apr 1975).

Radar measurements made with high spatial resolution and large dynamic range at the Jicamarca Radar Observatory near the time of reversal of the electrojet current provide further proof that the gradient drift instability is in fact responsible for the type 2 irregularities. Echoes are received over a much wider range of altitudes at night than during the day partly because of the change in character of the background electron density profile and partly because of recombination effects, which can be important during the day. It is also shown that one must be cautious, particularly at night, in associating the mean Doppler shift of oblique radar echoes with the maximum east-west electron drift velocity. (auth)

9966 THE MAGNETOSHEATH ELECTRON POPULATION AT LUNAR DISTANCE: GENERAL FEATURES. Reiff, P.H.; Reasoner, D.L. (Department of Space Physics and Astronomy, Rice University, Houston, Texas 77001). J. Geophys. Res. 80: No. 10, 1232-1237 (1 Apr 1975).

The spatial extent and energy distribution function of the magnetosheath electron population at lunar distance have been analyzed by using measurements from the Apollo 14 charged particle lunar environment experiment (CPLEE). The magnetotail is shown to be approximately 52 R_E in diameter. The mean bow shock surface has a cross section of about 91 R_E. The average aberration angle measured is about 3°. The electron distribution function reveals two distinct particle populations. The first, at low energies ($40 \text{ eV} \leq E \leq 200 \text{ eV}$), is well characterized by a nearly isotropic Maxwellian distribution, with temperatures in the range 15–25 eV. Densities calculated from fitted functions range from 4–8 cm^{-3} at the bow shock to 1–2 cm^{-3} near the magnetopause. The high-energy portion of the spectrum ($200 \text{ eV} \leq E \leq 2000 \text{ eV}$), however, is generally anisotropic and is generally denser and more energetic in the dawn magnetosheath than in the dusk magnetosheath. Separate Maxwellian fits to the high-energy population yield densities near 0.02(0.10) cm^{-3} and temperatures near 200(250) eV for the dusk (dawn) magnetosheath. It is argued that these particles originate at the bow shock rather than in the plasma sheet. (auth)

9967 PIONEER 7 OBSERVATIONS OF PLASMA FLOW AND FIELD REVERSAL REGIONS IN THE DISTANT GEOMAGNETIC TAIL. Walker, R.C.; Villante, U.; Lazarus, A.J. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Geophys. Res. 80: No. 10, 1238-1244 (1 Apr 1975).

We present the results of an extensive analysis of plasma and magnetic field data from Pioneer 7 taken in the geomagnetic tail approximately 1000 R_E downstream from earth. The principal observations are (1) measurable fluxes of protons in the tail, flowing away from earth, sometimes with a double-peaked velocity distribution; (2) field reversal regions in which the field changes from radial to antiradial by a vector rotation in the north-south plane; and (3) general characteristics of the tail similar to those observed near earth with good correlation between taillike magnetic fields and plasma. (auth)

9968 DOUBLE STREAMS OF PROTONS IN THE DISTANT GEOMAGNETIC TAIL. Villante, U.; Lazarus, A.J. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Geophys. Res. 80: No. 10, 1245-1247 (1 Apr 1975).

Two intermingled streams of protons have been observed in the distant geomagnetic tail. The number densities of the two streams are comparable, and their velocity difference tends to lie along the field direction. The lower-velocity stream is probably composed of magnetosheath protons which have diffused through the boundary of the distant tail. The higher-velocity stream appears to originate in the field reversal region. (auth)

9969 EXPLORER 45 OBSERVATIONS OF 1- TO 30-Hz MAGNETIC FIELDS NEAR THE PLASMAPAUSE DURING MAGNETIC STORMS. Taylor, W.W.L.; Parady, B.K.; Cahill, L.J., Jr. (School of Physics and Astronomy and Space Science Center, University of Minnesota, Minneapolis, Minnesota 55455). J. Geophys. Res. 80: No. 10, 1271-1286 (1 Apr 1975).

Observations have been made of <30-Hz magnetic fluctuations, some of which appear to be ion cyclotron waves, during initial, main, and recovery phases of magnetic storms. Such storm-related observable low-frequency events occur very infrequently, in only 10 instances in more than 2000 hours of data, including approximately 100 passes through storm time ring currents. All events were observed while the satellite was near the plasmapause and in the proton ring current. The wave amplitudes were typically 1 γ and as large as 5 γ in the frequency range from 1 to 3 Hz, with lower amplitudes in the 3- to 30-Hz range. On the basis of the spectral shape and intensity of the fluctuations the waves were presumed to be primarily ion cyclotron waves. Reasonable agreement was found between calculated ring current proton lifetimes while the protons were under the influence of ion cyclotron waves and observed proton lifetimes during parts of the December 1971 and August 1972 magnetic storms. These observations during times when the ring current and plasmasphere were close and often overlapping do not prove that the waves were generated by the ion cyclotron instability or that the ion cyclotron waves were necessarily responsible for proton ring current loss. The observations do suggest that ion cyclotron waves are unstable in such cases and that proton lifetimes are consistent with loss from ion cyclotron turbulence. Further theoretical (ion cyclotron wave growth limits) and observational (proton energy and pitch angle distribution changes during these or similar events) studies are required before the role of the ion cyclotron instability in ring current dynamics can be completely determined. (auth)

9970 INTERPRETATION OF THE RESONANCE INTERACTION OF CHARGED PARTICLES WITH AN ELLIPTICALLY POLARIZED PLASMA WAVE. Sazhin, S. S. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 460-462(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 543-545(1974).

The solution of the Vlasov–Maxwell equations for wave propagation in a cold magnetized plasma is known to describe in some cases elliptically polarized waves. These waves play an important part in magnetospheric dynamics and have several special names, depending on their frequency and the direction of the wave vector. The interaction of these waves with the energetic component of the magnetospheric plasma can lead both to attenuation or buildup. (WDM)

9971 INVESTIGATION OF THE VARIATIONS OF THE CARRIER FREQUENCY OF TYPE Pc1 GEOMAGNETIC PULSATIONS. Dovbnya, B. V.; Kalisher, A. L.; Matveeva, E. T. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 431-434(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 512-515(1974).

The effect of variations in the carrier frequency of Pc1 pulsations is examined. The dependence of these variations on local time and magnetic disturbance is investigated by analyzing the dynamic spectra of the pulsations. The large-scale electric field in the magnetosphere, responsible for the variations of the spectrum of Pc1 series, is estimated. (auth)

9972 HYDROMAGNETIC WAVE PROPAGATION IN A THREE-DIMENSIONAL MAGNETOSPHERE. I. Van'yan, L. L.; Lipatov, A. S. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 417-421(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 496-501(1974).

The three-dimensional nonstationary problem of small oscillations of a cold magnetospheric plasma upon interaction with large-scale solar-wind inhomogeneities is solved numerically in the magnetohydrodynamic approximation. The initial geomagnetic field and the geometry of the magnetosphere are selected on the basis of the study of Mead and Beard. The pressure of the solar wind on the magnetopause is approximated by Newton's law. (auth)

9973 EVOLUTIONARY STATE OF ANISOTROPIC ROTATIONAL PLASMA PRESSURE SHOCK WAVES AND THEIR APPLICATIONS TO SPACE. Ivanov, K. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 454-456 (1974).

Translated from Geomagn. Aeron.; 14: No. 3, 538-539(1974).

Theory suggests the existence of specific rotational anisotropic plasma-pressure shock waves of practical importance to space research. Three characteristic discontinuity surfaces can be identified with such waves, including: the boundary of the magnetosphere (magnetopause); the boundary of the plasma sheet of the tail of the magnetosphere; and the boundary of the region of the expanded interplanetary magnetic field reflected in the structure of geophysically effective interplanetary flows. The stability (evolutionary state) of such waves, separating two slightly disturbed regions of steady flow is analyzed. (WDM)

9974 DIFFERENTIAL ENERGY SPECTRA FOR EXPONENTIAL DISTRIBUTIONS BY ADIABATIC INVARIANTS. Gubar, Yu. I.; Shabanskii, V. P. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 3, 456-458(1974).

Translated from Geomagn. Aeron.; 14: No. 3, 540-541(1974).

The differential energy spectra that follow for the exponential distributions by adiabatic invariants are examined. (WDM)

9975 DISCRETE, CONTINUOUS, AND DIFFUSE AURORAS. Akasofu, S. I. (Univ. of Alaska, College). Planet. Space Sci.; 22: No. 12, 1723-1726(Dec 1974).

It is pointed out that there are a number of important differences between discrete auroras and diffuse auroras in the midnight sector. The differences are listed in a tabular form. The identification of the corresponding regions in the magnetotail is an urgent future task. (auth)

9976 MAGNETIC ENVELOPE OF THE EARTH. Semenov, A. S. Vestn. Leningrad. Univ., Geol., Geogr.; 18: No. 3, 40-43 (Sep 1974). (In Russian).

Attention is drawn to the zonal physical properties of the earth. Existence of a magnetic mantle at the depth 100–200 km is proved. Heterogeneity and change of the magnetic mantle with time has been contemplated as the possible reason for the continental magnetic anomalies and secular change of the magnetic field. (auth)

9977 INVESTIGATION OF ELECTRON DYNAMICS IN THE MAGNETOSPHERE WITH ELECTRON BEAMS INJECTED FROM SOUNDING ROCKETS. Winckler, J. R. (Minnesota Univ., Minneapolis (USA). School of Physics). J. Geophys.; 40: No. 6, 729-749(Dec 1974).

An empirical study of the basic mechanisms by which electrons precipitate from the geomagnetic field to produce "auroral x-rays" during periods of geomagnetic activity is described. The discussion is based on the results of balloon- and Echo I, II, III experiments. (BJ)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 8576, 9531, 9586, 10039–10042, 10044, 10610–10611, 10613, 10616–10620, 10624–10627, 10634, and 10643.

9978 (GSI-tr-22/74) PRODUCTION OF CARBON AND NITROGEN NUCLEI OF MULTICHARGED ARGON AND XENON IONS IN THE ELECTRON BEAM ION SOURCE. Donets, E. D.; Pikin, A. J. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). Oct 1974. 12p. (In German). INIS.

6 figs.; 11 refs. Translated from the Russian report JINR-P-7-7999.

In the electron beam multicharged ion source with a superconductive solenoid the product of electron flux density and electron-ion interaction time about 1×10^{19} cm^{-2} at an electron energy of 2.5 keV was realized. The beams of carbon ($_6C^{+6}$) and nitrogen ($_7N^{+7}$) nuclei as well as of argon ($_{14}A^{+14}$) and xenon ($_{54}Xe^{+22}$) ions were produced. Preliminary experimental data on sequential ionization cross sections of positive ions of the above mentioned chemical elements were obtained. (orig.)

9979 ATOMIC COLLISIONS IN SOLIDS. Volume 1. Conference Held at Gatlinburg, Tennessee, September 24-28, 1973. Datz, S.; Appleton, B. R.; Moak, C. D. (eds.). New York; Plenum Publishing Corporation (1975). 502p. (CONF-730958-P1). $39.50.

Primary atomic collision processes, states of ions penetrating solids and their relation to macroscopic effects are covered. Sections included are: Electronic Stopping, Radiation Damage (crystal damage), Computer Simulation, Screening and Charge Exchange, and X-rays. Separate abstracts are presented for 40 papers. (GHT)

For abstracts of individual papers see: 8576, 9980–9985, 10038–10044, and 10600–10625.

9980 COMPUTER SIMULATION OF ATOMIC COLLISIONS IN SOLIDS. Jackson, D. P. (Atomic Energy of Canada Ltd., Chalk River, Ontario). pp 185-197 of Atomic Collisions in Solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

A discussion of the application of computer simulation to atomic collision phenomena in solids is presented, organized under three main headings: (a) technique, (b) the applications of simulation, and (c) the advantages and limitations of simulation. The aim is not to be comprehensive but rather the emphasis is on the nature and uses of the simulation process with examples from the field of particle-crystal interactions. (37 references) (auth)

9981 ELECTRON SPIN POLARIZATION AT FERROMAGNETIC SINGLE CRYSTALLINE NICKEL SURFACES DETERMINED THROUGH ELECTRON CAPTURE BY SCATTERED DEUTERONS. Rau, C. (Univ., Munich); Sizmann, R. pp 295-303 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

A beam of 150 keV deuterons is scattered at grazing incidence on a nickel single crystal surface (hkl) placed in a magnetic field. Polarized electrons captured by the scattered deuterons can orient the deuteron nuclei via the hyperfine interaction. Their polarization is then a measure of the original electron polarization and is determined from the angular distribution of the alpha-particles emitted in a T(d,n)^{4}He reaction. The electron spin polarization is found to be parallel to the magnetizing field in the nickel at (100) [110], (110) [110], (111) [1 anti 21], and (111) [110], antiparallel in (120) [anti 210]. The symbols in the brackets indicate the beam direction, the magnetization being in the plane and perpendicular to the beam direction. An electron spin polarization of (96.1 ± 2.8) percent is found at the (110) surface, other surfaces giving as yet lower values. (auth)

9982 SOLID EFFECTS ON INNER SHELL IONIZATION. Saris, F. W. (Inst. for Atomic and Molecular Physics, Amsterdam). pp 343-363 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

X-ray yields from ion bombardment of solid or gaseous targets differ markedly, due to the steady state excitation of the projectile when penetrating a solid target, and due to recoil effects. The observed influence of outer-shell ionization on inner-shell excitation yields information on the state of energetic ions moving through solids. It is observed that the equilibrium fraction of ions which have one or more inner-shell vacancies can be as large as 10-100 percent. This leads necessarily to collision-induced deexcitation processes one of which is the emission of MO x rays. These charge state effects are reviewed along with an illustration of the importance of recoil effects as well as a discussion of possible future investigations. (13 figs, 37 refs) (auth)

9983 ION EXCITATION OF Al K X-RAY SPECTRA. Knudson, A. R.; Burkhalter, P. G.; Nagel, D. J. (Naval Research Lab., Washington, DC). pp 421-432 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

High resolution measurements of ion-excited Al K spectra were extended to include Al projectile spectra and Al target spectra excited by heavier projectiles (Ar,Ni). Spectra from 3.0-MeV Al projectiles showed that the number of L vacancies present at the time of K vacancy decay is determined largely by collisions subsequent to production of the K vacancy. Heavy projectiles on Al targets produce Al spectra which appear to be the result of two ionization mechanisms operating simultaneously. Molecular orbital formation may enter into the interpretation of satellite structure in both Al projectile and Al target spectra. (9 figs, 14 refs) (auth)

9984 X-RAY EMISSION FOLLOWING ION BEAM AND PLASMA EXCITATIONS. Nagel, D. J. (Naval Research Lab., Washington, DC). pp 433-445 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The hallmark of much recent work in x-ray spectroscopy is the study of emission from high ionization states. Such states can be produced by heavy-ion impact or in very hot plasmas. Ion excitation is a flexible way to produce spectra similar to and intermediate between those resulting from electron beam and plasma excitation. Ion excited x-ray spectra are useful in atomic and collision physics research. High temperature plasmas occurring in fusion power devices emit intense x radiation which provides a useful diagnostic of conditions within such plasmas. X-ray spectra from ion impact and hot plasmas are compared. They are shown to be complementary in some cases and very similar in others. (9 figs, 17 refs) (auth)

9985 EXCITATION STATES OF PROJECTILES MOVING THROUGH SOLIDS. Fortner, R. J. (Univ. of California, Livermore); Garcia, J. D. pp 469-478 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

X-ray spectral measurements of S, Cl, and Ar atoms moving in solid carbon targets are used to extract the equilibrium distribution of vacancies in the valence and L-shells of the projectiles. It is found that the state of excitation is much higher than the mean charge measured after the projectile has left the solid. A simple model is used to deduce the expected final charge state distribution, and these are compared to thin foil measurements. (auth)

9986 ELECTRON ENERGY LOSS MEASUREMENTS ON *p*-terphenyl ($C_{18}H_{14}$) SINGLE CRYSTALS AND VAPOR. Venghaus, H.; Hinz, H. (Institut für Angewandte Physik der Universität, Hamburg, Federal Republic of Germany). J. Chem. Phys. 62: No. 12, 4937-4940 (15 June 1975).

Electron energy loss spectra with 50 keV electrons were taken on *p*-terphenyl single crystals and vapor from 0–40 eV and 0–25 eV, respectively. The orientation of the main axes of the dielectric tensor is determined by means of symmetry considerations and the energy loss functions $\mathrm{Im}(-1/\epsilon_{ii})$ $(i=x, y, z)$ are derived from energy loss spectra taken with transferred momentum of the scattered electrons parallel to the tensor main axes. From $\mathrm{Im}(-1/\epsilon_{ii})$ the main axis elements ϵ_{ii} of the dielectric tensor are calculated by Kramers–Kronig analysis. The lower crystal excitations ($E \lesssim 8$ eV) are discussed in terms of excited molecular states, derived from the vapor spectra and taken from optical absorption data given in the literature. Values for the crystal and solution shift of π–π^* excitations are obtained. (auth)

9987 ASYMPTOTIC EXPRESSION FOR *K*-SHELL IONIZATION CROSS SECTION WITH ELECTRONS. Kolbenstvedt, H. (University

of Trondheim (NLHT), Trondheim, Norway). J. Appl. Phys. 46: No. 6, 2771-2773 (June 1975).

The total cross section for *K*-shell ionization with electrons as given is a function of the *K*-shell screening parameter θ for target elements with $Z \gtrsim 13$ and incident electron energies much higher than the *K*-shell binding energy. For an incident electron energy of 300 MeV, the cross section varies with the atomic number approximately as $Z^{-2.55}$ compared to the experimental result $Z^{-2.69}$. (auth)

9988 AN ANALYTIC SOLUTION TO ELASTIC BACKSCATTERING. Chu, W.K.; Ziegler, J.F. (IBM—Research, Yorktown Heights, New York 10598). J. Appl. Phys. 46: No. 6, 2768-2770 (June 1975).

An approximate analytic expression is presented for the prediction of spectra obtained from nuclear elastic backscattering from elemental matter, e.g., $^4He^+$ from Al. Beam energy straggle in the target and experimental resolution limitations are not considered. Theoretical calculations are shown to agree well with experimental spectra. (auth)

9989 HEAVY-ION SPUTTERING YIELDS OF GOLD: FURTHER EVIDENCE OF NONLINEAR EFFECTS. Andersen, H.H.; Bay, H.L. (Institute of Physics, University of Aarhus, DK-8000 Aarhus C, Denmark). J. Appl. Phys. 46: No. 6, 2416-2422 (June 1975).

The sputtering yield of vacuum-deposited gold targets has been measured with 18 different 45-keV ions throughout the periodic system. The results are compared with previously reported results obtained with copper, silicon, and silver targets and with the predictions of the Sigmund theory. The variation in the yield with projectile atomic number is found to be consistent with theory although rather large deviations are found for both heavy and light projectiles. The large experimental yields for heavy projectiles as well as the maximum in the energy dependence of the yield, which is more pronounced than predicted by theory, are explained by nonlinear effects in very dense collision cascades. This interpretation is supported by data obtained from irradiation with atomic and molecular ions of the same elements. The deviations for light projectiles are considered mainly to be due to the lack of a surface correction term in the theory. (auth)

9990 SPECTRAL SHAPE AND CROSS SECTION OF MOLECULAR-ORBITAL X—RAY CONTINUA FROM HEAVY-ION COLLISIONS. Betz, H.; Bell, F.; Panke, H.; Stehling, W.; Spindler, E. (Sektion Physik, Universität München, 8046 Garching, Germany); Kleber, M. Phys. Rev. Lett. 34: No. 20, 1256-1259 (19 May 1975).

We investigate molecular-orbital (MO) x-ray transitions resulting from collisions between 7–95-MeV sulfur ions and various thin, solid targets. MO radiation profiles beyond the united-atom limit are measured over several orders of magnitude in intensity, and absolute contributions of spontaneous and induced MO x rays are identified. We discuss formulations of MO theories which are in excellent agreement with our experimental spectral shapes and cross sections. (auth)

9991 *K*-SHELL X–RAY PRODUCTION CROSS SECTIONS OF SELECTED ELEMENTS FROM Ti TO Y FOR 0.5- TO 2.5-MeV ALPHA-PARTICLE BOMBARDMENT. McDaniel, F.D.; Gray, T.J.; Gardner, R.K. (Department of Physics, North Texas State University, Denton, Texas 76203). Phys. Rev. A 11: No. 5, 1607-1613 (May 1975).

K-shell x-ray production cross sections and $K\beta/K\alpha$ ratios have been measured for thin targets of Ti, V, Cr, Fe, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, and Y for 0.5- to 2.5-MeV alpha particles. The experimental values are compared to the nonrelativistic plane-wave Born approximation (PWBA), the binary-encounter approximation, and the PWBA with binding energy and Coulomb deflection corrections. The PWBA with corrections provides the best agreement with the experimental cross sections. (auth)

9992 NEGATIVE ELECTRON AFFINITY GaAs: A NEW SOURCE OF SPIN-POLARIZED ELECTRONS. Pierce, D.T.; Meier, F.; Zürcher, P. (ETH-Laboratorium für Festkörperphysik, 8049 Zürich, Switzerland). Appl. Phys. Lett. 26: No. 12, 670-672 (15 June 1975).

The spectrum of spin polarization and yield of photoelectrons from negative electron affinity GaAs were measured. The results show that GaAs is an excellent source of polarized electrons with $P \sim 50\%$, high current, small energy spread, and high brightness. (auth)

9993 SPUTTERING OF SILICON AND GALLIUM ARSENIDE WITH MEDIUM ENERGY INTENSE ION BEAMS OF ARGON AND XENON. Pearmain, K.; Unvala, B. A. (Imperial Coll. of Science and Tech., London). Vacuum; 25: No. 1, 3-7(Jan 1975).

Single crystal and polycrystalline targets of Si and GaAs have been bombarded at 60° to their surface normal with 1 to 6 mA beams of Ar^+ and Xe^+ ions with energies between 6 and 12 keV in a vacuum of 10^{-4} torr. The distribution of the sputtered material and sputtering yield have been investigated and correlated with the bombardment induced surface disorder. Stoichiometrically sputtered layers of GaAs were obtained from polycrystalline GaAs sources. (auth)

9994 PRODUCTION OF FOCUSED ION BEAMS FOR SURFACE AND GAS-PHASE COLLISION STUDIES. Hurley, R. E. (Edwards High Vacuum Ltd., Crawley, Eng.). Vacuum; 25: No. 4, 143-149(Apr 1975).

Factors limiting the performance of practical ion beam systems are discussed and include momentum dispersion, instabilities, space-charge repulsion and extraction optics. An approach to overall design is illustrated by an accelerator system employing low energy extraction and used for a range of working conditions and ion species. (auth)

9995 A SIMPLE CALCULATION OF THE ANGULAR DISTRIBUTION OF SPUTTERED ATOMS. Roedelsperger, K.; Krueger, W.; Scharmann, A. (Giessen Univ. (F. R. Germany). 1. Physikalisches Inst.). Z. Phys., A.; 272: No. 1, 127-130(1975).

Part of a thesis by K. Roedelsperger.

Angular distributions of atoms sputtered with fast ions from smooth amorphous targets are estimated by a straightforward treatment of the collision cascade. When the geometrical situation at oblique ion impact is considered, the angle of maximum emission and the sputtering yield in dependence on the angle of ion incidence are described. (auth)

9996 APPARENT REFLEXION OF FAST ELECTRONS FOR GLANCING INCIDENCE. Abou Mandour, M.; Harder, D. (Goettingen Univ. (F. R. Germany). Inst. fuer Medizinische Physik und Biophysik). Z. Naturforsch., A; 30: No. 2, 265-268(Feb 1975). (In German).

Backscattering of 20-MeV electrons from lead is simulated by a Monte Carlo code for varied angles of incidence. For glancing incidence, the most probable exit angle approaches the reflection angle, and the most probable energy approaches the initial energy. The underlying mechanism is derived from the calculations. (auth)

9997 OBSERVATION OF A SELF-COLLIDING BEAM. Maglich, B.; Mazarakis, M. (Fusion Energy Institute, Fusion Energy Corporation, P. O. Box 2005, Princeton, New Jersey 08540); Robinson, B.; Galayda, J.; Gore, R.; Colleraine, A.P. Appl. Phys. Lett. 26: No. 11, 609-612 (1 June 1975).

A single beam of accelerated deuterium ions, D^+_2, of 108 keV, injected into a highly inhomogeneous magnetic field, decreasing quadratically with the radial distance from the center, was made to collide head-on with *itself*. The trajectory of the "self-colliding beam" is a precessing figure 8, with the ions moving clockwise in both (upper and lower) loops and colliding head-on in the center. (auth)

9998 EXPERIMENTS ON A COLD CATHODE PENNING ION SOURCE FOR THE GENERATION OF MULTICHARGED HEAVY IONS. Wolf, B. Heidelberg; Univ. Heidelberg (1973). 66p. (In German). INIS.

Thesis.

The discharge characteristics of a cold-cathode penning ion source was investigated for several different cathode materials for the rare gases. The yield of multicharged rare gas ions was measured in dependence of the discharge parameters. During the ion generation the step ionization predominates over the single collision ionization. Further experiments were carried out to generate and measure the emittance of ions of the elements S, Ti, Br, Se, Cd, J, and Bi. (GE)

9999 SPECULAR REFLECTION OF ^4He ATOMS FROM THE SURFACE OF LIQUID ^4He. Edwards, D.O.; Fatouros, P.; Ihas, G.G.; Mrozinski, P.; Shen, S.Y.; Gasparini, F.M.; Tam, C.P. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. Lett. 34: No. 18, 1153-1156 (5 May 1975).

Measurements with a pulsed ^4He atomic beam incident on the surface of liquid ^4He at $T=0.03$ *K* show that the probability of specular reflection depends only on the perpendicular momentum of the atom $\hbar k \cos\theta$ and that it varies smoothly from 4×10^{-2} to less than 10^{-4} for $k \cos\theta$ in the range from 0.05 to 0.6 $Å^{-1}$. The probability of diffuse inelastic scattering is less than 2×10^{-3}. Contrary to theoretical expectations, there is no significant change in the reflection probability at the roton threshold at $k=0.5$ $Å^{-1}$. (auth)

Atomic and Molecular Properties

Refer also to abstracts 8579, 9369, 10030, 10051, 10066–10067, 10076, 10631, and 10684.

10000 ION KINETIC ENERGY DISTRIBUTIONS FROM DISSOCIATIVE PHOTOIONIZATION OF MOLECULAR HYDROGEN. Ford, A.L. (Department of Physics, Texas A and M University, College Station, Texas 77843); Docken, K.K. J. Chem. Phys. 62: No. 12, 4955-4957 (15 June 1975).

The kinetic energy distributions for the dissociative photoionization of ground and vibrationally excited H_2 to the dissociative continuum of the $1s\sigma_g$ state of H^+_2 are calculated. (AIP)

10001 ANALYSIS OF THE DYNAMICS OF A HELIUM DISCHARGE BY MEANS OF THE FOURIER AMPLITUDE SENSITIVITY TEST. Peatman, W.B.; Wu, D.T. (Department of Chemistry, Vanderbilt University, Nashville, Tennessee 37235); Barach, J.P. J. Chem. Phys. 62: No. 12, 4835-4841 (15 June 1975).

The development of a method to analyze the chemical dynamics of a repetitively excited chemical system is given along with the analysis of a helium plasma and the implications of the analysis. The method is based upon (1) numerical (Runge–Kutta–Gill) solutions to the coupled differential equations which govern the discharge and (2) the application of the recently described "Fourier Amplitude Sensitivity Test" (FAST) to the solutions, which enables one to determine the principal dependence of each species on the fundamental rate processes present. The results of this analysis are generally in agreement with previous work but go further in giving a picture of the detailed dynamics. (auth)

10002 MANY-BODY PERTURBATION THEORY APPLIED TO H_2. Kaldor, U. (Chemistry Department, Tel-Aviv University, Tel-Aviv, Israel). J. Chem. Phys. 62: No. 12, 4634-4638 (15 June 1975).

Diagrammatic many-body perturbation theory is applied to the H_2 molecule using a discrete basis set composed of Gaussian orbitals. Three different zero-order potentials are tried. Corrections through third order are calculated, and higher orders are estimated. The energy obtained is accurate to about 1 kcal/mole. The technique of partial summation of certain classes of diagrams by denominator shifts is investigated. Dipole polarizabilities and transition moments are also calculated, with an accuracy of 5% or better. The use of the geometric approximation to estimate high-order corrections is discussed. (auth)

10003 RESONANCE LINES OF Cs II, Ba III, AND La IV Reader, J. (National Bureau of Standards, Washington, D. C. 20234); Epstein, G.L. J. Opt. Soc. Am. 65: No. 6, 638-641 (June 1975).

The resonance line spectra of ions in the Xe I isoelectronic sequence, consisting of the 5 transitions to the $5p^6\ ^1S_0$ ground state from levels with $J = 1$ in the $5p^5 5d$ and $6s$ configurations, have been observed for Cs II, Ba III, and La IV. The observations were made with a sliding spark on the 10.7-m normal-incidence vacuum spectrograph at NBS. The resonance transitions from the $5p^5 6d$ and $7s$ configurations were also observed for these ions, except for that from $5p^5 6d\ ^3P_1$ of Ba III. Several resonance transitions from higher nd and ns levels were also observed. Estimated values for the $J = 1$ levels of the $5p^5 7s$ configuration of Ce V were obtained by extrapolation. The derived ionization energies in eV are Cs II 23.17(4), Ba III 35.79(6), La IV 45.95(6), Ce V 65.55(25). (auth)

10004 HIGH-RESOLUTION LASER SPECTROSCOPY OF THE *D* LINES OF ON-LINE PRODUCED ^{21,22,24,25}Na USING A NEW HIGH-SENSITIVITY METHOD OF DETECTION OF OPTICAL RESONANCES. Huber, G.; Thibault, C.; Klapisch, R. (Laboratoire René Bernas du Centre de Spectrométrie Nucléaire et de Spectrométrie de Masse, 91406 Orsay, France); Duong, H.T.; Vialle, J.L.; Pinard, J.; Juncar, P.; Jacquinot, P. Phys. Rev. Lett. 34: No. 19, 1209-1211 (12 May 1975).

A polyisotopic sodium beam of $^{21-25}$Na, produced by spallation of Al, was illuminated with a tunable cw dye laser. The atomic beam, analyzed by a six-pole magnet is then ionized and detected by use of a mass spectrometer. The results are as follows: isotopic shifts relative to ^{23}Na, ^{21}Na = −53.5 mK, ^{22}Na = −25.3 mK, ^{24}Na = +23.1 mK, ^{25}Na = +44.6 mK; $\mu_I(^{25}\text{Na}) = +3.685(22)\ \mu_N$; b factor in the $P_{3/2}$ state of ^{25}Na = −16(8) MHz. (auth)

10005 COULOMB PERTURBATION CALCULATIONS IN MOMENTUM SPACE AND APPLICATION TO QUANTUM-ELECTRODYNAMIC HYPERFINE-STRUCTURE CORRECTIONS. Douglas, M. (Department of Physics, University of California, San Diego, La Jolla, California 92037). Phys. Rev. A 11: No. 5, 1527-1538 (May 1975).

Adaptation of the momentum-space Schrödinger-Coulomb Green's function for second-order perturbation calculations of the bound-state energy levels of hydrogenic atoms is demonstrated. The numerical viability of the formulas derived is proven by recalculating the contribution in second order of the spin-spin operator to the hydrogen hyperfine-structure residual $R = (8\nu_{23} - \nu_{15})/\nu_{15}$. Application to positronium hyperfine structure is discussed. (auth)

10006 PROBLEM OF EMISSION FROM A HYDROGENLIKE ATOM. Semenov, V. P. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 131-132(1975). (In Russian).

A solution of Maxwell's equation was obtained that generalizes a coulombic solution in electrostatics to the case of the presence of curvature in the cosmological background. It is assumed that space has a measuring system realized by one of the models of Friedman, and that the electromagnetic field itself does not introduce noticeable distortions into the geometry. An equation is given for the potential, and a study is carried out of the effect of the modified coulombic potential on the energy spectrum of a hydrogen-like atom. The corresponding corrections are extremely small, and it is found that the change in ionization potential of hydrogen is far below the experimental ability to detect these changes. An unexpected conclusion from this study is that the presence of a cosmological gravitational field makes impossible the existence of a free electron having a continuous energy spectrum. (SJR)

10007 SPIN RECOUPLING AND N-ELECTRON MATRIX ELEMENTS. Gouyet, J. F.; Schranner, R.; Seligman, T. H. (Ecole Polytechnique, Paris). J. Phys., A (London); 8: No. 3, 285-298(Mar 1975).

For n-electron systems with well defined total spin antisymmetric states are constructed by successively coupling the spins associated with each orbital. A second quantized scheme is used and the matrix elements of these states are expressed both for spin-independent and spin-dependent interactions in terms of recoupling coefficients of SU(2). The latter are evaluated to give very simple expressions. As a particular case a simple formula for the matrix elements of generators of U(N) for two-column partitions is obtained. (auth)

10008 IMPROVED QUANTUM CALCULATION OF THE VIBRATIONAL EXCITATION OF H_2 IN COLLINEAR COLLISIONS WITH HELIUM. Drake, G. W. F.; Holt, A. R. (Windsor Univ., Ont.). J. Phys., B (London); 8: No. 3, 494-502(21 Feb 1975).

The vibrational excitation probabilities of H_2 in collinear collisions with He are calculated quantum mechanically, using the Fredholm integral method. Important differences are found when the accurate H_2 molecular potential of Kolos and Wolniewicz (J. Chem. Phys.; 43: 2429-41 (1965) and 49: 404-10 (1968)) is used instead of the less accurate Morse potential used extensively in previous work. The approximation of truncating the infinite set of coupled equations describing the collision problems is tested, and an alternative closure approximation is suggested to provide an indication of the effect of truncation on the results. (auth)

10009 DETERMINATION OF CHARGE TRANSFER IN TETRATHIAFULVALENE–TETRACYANOQUINODIMETHANE TTF–TCNQ) FROM PHOTOEMISSION SPECTROSCOPY. Epstein, A. J.; Lipari, N. O.; Nielsen, P.; Sandman, D. J. (Xerox Webster Research Center, NY). Phys. Rev. Lett.; 34: No. 14, 914-916 (7 Apr 1975).

Calculation of Coulomb-potential differences for nonequivalent atomic sites and comparison with the reported experimental x-ray-photoemission splittings, combined with a comparison of the valence electronic structure with that of other TCNQ salts, show that the degree of charge transfer in TTF-TCNQ is not unequivocally determined by photoemission spectroscopy. (auth)

10010 INTERNUCLEAR DISTANCE IN N_2, GAS AND LIQUID, BY NEUTRON DIFFRACTION. Page, D. I. (United Kingdom Atomic Energy Authority, Harwell, Eng.); Powles, J. G. Mol. Phys.; 29: No. 4, 1287-1291(Apr 1975).

A brief review is presented of previous studies of the internuclear distance (d) in the nitrogen molecule. It was concluded that it was necessary to reconsider the value for d for the nitrogen molecule as measured in the liquid. The slow neutron scattering cross section for nitrogen gas was measured to high momentum transfer ($Q_{max} = 40\ \text{Å}^{-1}$) so that a direct comparison could be made with the corresponding results for the liquid. Comparisons are made and conclusions drawn. (UK)

10011 THORIUM COMPARISON SPECTRUM. Breckinridge, J.B.; Pierce, A.K.; Stoll, C.P. (Kitt Peak National Observatory). Astrophys. J. Suppl. Ser. 29: No. 278, 97-112 (Mar 1975).

Wavelengths for approximately 1850 thorium emission lines between 2720 and 8805 A are given. The accuracy of these measures appears to be better than ±0.001 Å. These measures, made from photographic plates taken with the 13.7-m focal length grating spectrograph at the McMath Solar Telescope at Kitt Peak, are part of work done for the solar wavelength atlas program (Pierce and Breckinridge, *Kitt Peak Contributions* 559, 1973). We suggest they be used for general stellar and solar comparison wavelengths. (auth)

10012 OPTICAL EXCITATION OF THE DAUGHTER ATOM Sc BY A SUDDEN CHANGE OF NUCLEONIC CHARGE IN THE BETA DECAY OF Ca^{45} IN SOLID Xe. Gerth, G. Munich; Technische Univ. (1972). 69p. (In German). INIS.

Thesis.

By the perturbation of the atomic shell with a sudden change of nucleonic charge as a result of nuclear decay, it is possible that the electron shell of the product ion enters an excited state. After this excitation had been detected in ^{85}Kr, the excitation of Sc after the β-decay of ^{45}Ca, incorporated in solid Xe could be investigated in this study. The measured results lead to the conclusions that the product atom present as excited Sc^+ ion, must be recombined (capture of a 3d electron) at the time of the emission in the observed spectral region; further, that together with the capture of a 3d electron, a dipole transition in the outer shell of the excited A_{1g} state of Sc^+ had taken place. (GE)

10013 ^1D AUTOIONIZATION SERIES IN HELIUM. Burch, D. (Department of Physics, University of Washington, Seattle, Washington 98195); Bolger, J.; Moore, C.F. Phys. Rev. Lett. 34: No. 17, 1067-1070 (28 Apr 1975).

Ten states of doubly excited He have been observed in a high-resolution electron-emission spectrum from 30-MeV O^{5+} + He collisions. Five lines can be identified as the $(2p\ np)^1D+$ series. The excitation mechanism is discussed and compared with results of an idential measurement using 4-MeV proton excitation. (auth)

10014 COUPLING CONSTANTS OF THE FINE AND HYPERFINE INTERACTION IN THE $c\ ^3\Pi_u$ METASTABLE STATE OF H_2. Jette, A.N. (Applied Physics Laboratory, The Johns Hopkins University, Silver Spring, Maryland 20910). J. Chem. Phys. 62: No. 11, 4579-4580 (1 June 1975).

Ab initio calculations of the fine and hyperfine coupling constants in the metastable state of molecular hydrogen are extended to internuclear distances of 1.90 and 2.00 a.u. From these results averaged coupling constants for the $N=1$ rotational state of orthohydrogen and the $N=2$ state of parahydrogen are obtained over the zeroth vibrational level. (AIP)

10015 COHERENCE MEASUREMENT OF TENSOR MULTIPOLES OF ASYMMETRICALLY EXCITED ATOMIC STATES. Church, D.A.; Michel, M.C.; Kolbe, W. (Lawrence Berkeley Laboratory, Berkeley, California 94720). Phys. Rev. Lett. 34: No. 18, 1140-1143 (5 May 1975).

A specific coherence measurement technique is described, which yields the relative magnitudes of all predicted orientation and alignment parameters in tilted-foil-excited levels of ions and atoms. Quantum-beat frequencies and relative magnitudes are measured as a function of applied magnetic field strength and direction, and analyzed using Fano-Macek theory. The multipole moments of tilted-foil-excited 40-keV ^4He $4d^1D_2$ atoms are measured and related to proposed excitation mechanisms. (auth)

10016 TWO-ELECTRON PHOTOIONIZATION OF THE HELIUM ATOM NEAR THRESHOLD. Yurev, M.S. Opt. Spectrosc. (USSR) 38: No. 1, 4-5 (Jan 1975).

The problem of two atomic electrons being knocked out by one photon has been examined. The cross section for this kind of process differs from zero only when electron correlations are taken into account. The correlation with regard to interaction between electrons is formulated by perturbation theory, and the correlation is computed for both initial and final states. Calculated matrix elements were derived with the aid of Coulomb Green's functions. A cross section for two-electron photoionization of the helium atom was obtained for the energy range of about 100 eV for the incident photon. The energy distribution of the photo-electrons knocked out was studied. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 10005, 10123, 10450, and 10642.

10017 (JINR-E1-8881) MEASUREMENT OF THE FORMATION RATE OF pdμ MESIC MOLECULES IN GASEOUS HYDROGEN. Bystritskii, V. M.; Dzhelepov, V. P.; Khemnits, G.; Filchenkov, V. V.; Khomenko, V. A.; Khovanskii, N. N.; Rudenko, A. I.; Suvorov, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 13p. (CONF-750631-1). Dep. NTIS (US Sales Only) $4.00.

From 6th international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

The pdμ rate of the pdμ mesic molecular production was measured in the experiment with a gas target filled with a hydrogen +7% deuterium mixture at a 43 atm. pressure by using the muon beam from the Dubna 680-MeV synchrocyclotron. Gamma-quanta from the fusion reaction in the pdμ molecule were detected with two NaI(Tl) spectrometers ϕ 150 mm × 100 mm large. The obtained value of the pdμ mesic molecule production rate was found to be $\lambda_{pd\mu} = (5.45 \pm 0.65) \times 10^6\ sec^{-1}$. (auth)

10018 POSITRON ANGULAR CORRELATION MEASUREMENTS WITH A Ge(Li) DETECTOR: A NEW APPROACH. Singru, R. M. (Indian Inst. of Tech., Kanpur). pp 85-87 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

10019 POSITRON ANNIHILATION IN LIQUID AND PLASTIC CRYSTALS. Kulkarni, V. G.; Dave, N. K. (Tata Inst. of Fundamental Research, Bombay). pp 218-220 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

10020 TEMPERATURE AND PHASE DEPENDENCE OF POSITRONIUM LIFETIMES IN HALOGEN-SUBSTITUTED BENZENES. Lagu, R. G.; Kulkarni, V. G.; Chandra, G.; Thosar, B. V. (Tata Inst. of Fundamental Research, Bombay). p 221 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27-31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

10021 POSITRONIUM FORMATION IN ICE. Falciglia, F.; Iaci, G.; Lo Savio, M.; Turrisi, E. (Catania Univ. (Italy). Istituto di Struttura della Materia). Appl. Phys.; 5: No. 2, 179-180(Nov 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

Applying a new method, based on integral measurements, it is demonstrated that there is a broadening of the narrow component in the gamma angular distribution curve when positrons annihilate in ice. This broadening seems to be imputable to the existence of Bloch states and justifies the discordance between theoretical and experimental values of the magnetic quenching. (auth)

10022 LIFETIME SPECTRA OF POSITRONS IN DEFORMED Ge. Kuramoto, E.; Takeuchi, S.; Noguchi, M.; Chiba, T.; Tsuda, N. (Tokyo Univ. (Japan). Inst. for Solid State Physics). Appl. Phys.; 4: No. 1, 41-45(Jun 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

Positron lifetime measurements were performed in n-type and p-type germanium single crystals deformed by compression. The results are compared with those of deformed GaAs single crystals obtained previously. In both n- and p-type germanium the lifetime τ_1 and its intensity I_1 decreased with deformation. Using the trapping model, the trapping rates of positrons by dislocations are obtained, which in turn gave the cross width of the dislocation as 20.0 A and 8.2 A for n-type and p-type germanium, respectively. (auth)

10023 POSITRON ANNIHILATION IN SOLID KRYPTON AND XENON. Sharma, B. K. (Rajasthan Univ., Jaipur (India). Dept. of Physics). Appl. Phys.; 5: No. 3, 265-267(Dec 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

A computation of the lifetime of positrons as well as the angular distribution of the resulting gamma pair for polycrystalline krypton and xenon was made. The calculations are based on the technique employed by Salvadori and Carbotte for the case of solid argon. The field seen by the positrons is constructed from the charge densities derived from Herman-Skillman wave functions. The positron wave functions are obtained using the Wigner-Seitz approximation. For electrons Herman-Skillman wave functions were used. The computed distributions, when the effects of correlation are ignored, are wider than the experimental ones. The calculated values for the mean lives of positrons for krypton and xenon are 2.2×10^{-9} sec and 2.7×10^{-9} sec, respectively, and that for xenon is, as usual, longer than the measured value of 0.43×10^{-9} sec. (auth)

10024 POSITRON ANNIHILATION IN γ-IRRADIATED PURE AND Mg-DOPED LiF. Hsu, F. H.; Mallard, W. C.; Fu, J. K. (Georgia State Univ., Atlanta (USA). Dept. of Physics). Appl. Phys.; 4: No. 1, 75-78(Jun 1974).

From 3rd international conference on positron annihilation, Otaniemi, Finland (7 Aug 1973).

Positron annihilation lifetime spectra in unirradiated and γ-irradiated pure LiF and heavily doped LiF: Mg were resolved into three components. The intensity of the intermediate lifetime component increases in proportion to the F-center concentration for both materials until saturation occurs (approximately 1.4×10^{17} cm^{-3} in LiF and approximately 5.7×10^{17} cm^{-3} in LiF: Mg). The presence of a large positive ion vacancy concentration appears to have a much smaller effect than has been observed in KCl: Ca. (auth)

10025 POSITRONIUM ATOM REACTIONS IN AQUEOUS SOLUTIONS OF IRON III COMPLEXES. Nichols, A. L.; Wild, R. E.; Bartal, L. J.; Ache, H. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Chemistry). Appl. Phys.; 4: No. 1, 37-40(Jun 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

The rate constants for the reactions between thermal Ps atoms and a series of iron (III) compounds including some complexes which can be considered as model compounds for biologically active systems were determined. (auth)

10026 POSITRON ANGULAR CORRELATION MEASUREMENTS ON SINGLE-CRYSTAL ALUMINUM AT VARIOUS TEMPERATURES. Triftshaeuser, W.; McGervey, J. D. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Appl. Phys.; 5: No. 2, 177-178(Nov 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

The trapping model by comparing the temperature dependence of the peak and the tail of the angular correlation curve from single crystal aluminum was tested. The integral over the tail decreased as the integral over the peak increased with temperature, in such a way that the same vacancy formation energy could be deduced from both integrals. (auth)

10027 EFFECT OF V_K CENTERS ON POSITRON ANNIHILATION IN KCl AND Ag-DOPED KCl. Hsu, F. H.; Mallard, W. C.; Hadley, J. H. Jr. (Georgia State Univ., Atlanta (USA). Dept. of Physics). Appl. Phys.; 4: No. 1, 83-86(Jun 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

Positron lifetime spectra were measured at 77 K for KCl and Ag-doped KCl before and after x-irradiation at 77 K and after annealing at room temperature. Radiation at 77 K reduces the intensity of the intermediate lifetime component. Radiation-induced defects were monitored optically and by ESR. The experiment shows that the changes observed in the positron decay are associated with the presence of color. (auth)

10028 THERMAL EXPANSION EFFECTS IN POSITRON LIFETIMES. Jamieson, H. C.; McKee, B. T. A.; Stewart, A. T. (Queen's Univ., Kingston, Ontario (Canada). Dept. of Physics). Appl. Phys.; 4: No. 1, 79-82(Jun 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

The precision of relative positron lifetime measurements is now sufficient to observe directly changes due to lattice thermal expansion. This information is necessary for the determination of accurate vacancy formation energies from positron annihilation data obtained over a higher temperature range. Measurements were made of the change in positron lifetime in the metals Au, Ag, Cu, and Al over the temperature range 100 to 300 K where there is no contribution from positron trapping at vacancies. (auth)

10029 FIRST MEASUREMENTS OF POSITRONIUM TOTAL SCATTERING CROSS SECTIONS. Spektor, D. M.; Paul, D. A. L. (Toronto Univ., Ontario (Canada). Dept. of Physics). Appl. Phys.; 5: No. 4, 383-384(Jan 1975).

Paper presented at the 3rd international conference on Positron Annihilation, Otaniemi, Finland, Aug 1973.

A new type of experiment was devised in which ortho-positronium diffusion to the metal walls of a series of parallel-sided cells is studied by measuring the annihilation lifetimes. Experimental results are subjected to an analysis in which two parameters are varied to give a best fit, one of the two parameters being the scattering cross section. (auth)

10030 LINEAR STARK EFFECT IN ATOMS AND MESIC ATOMS IN THE PRESENCE OF NEUTRAL WEAK CURRENTS. Gorshkov, V.G.; Labzovskiĭ, L.N. (Leningrad Institute of Nuclear Physics). JETP Lett. 21: No. 1, 8-9 (5 Jan 1975).

It is shown that in the presence of weak neutral currents a splitting of the Stark levels of the atoms takes place with respect to the sign of the projection of the total angular momentum. The resultant splitting is calculated. (auth)

10031 EFFECT OF π CONDENSATE ON THE REAL PART OF THE OPTICAL POTENTIAL IN A π-MESIC ATOM. Troitskiĭ, M.A.; Sapershtein, É.E.; Markin, O.A.; Mishustin, I.N. (Physico-chemical Research Institute). JETP Lett. 21: No. 1, 44-45 (5 Jan 1975).

It is shown that the presence of a pion condensate in nuclei leads to an additional repulsion contribution in the *P*-wave terms of the optical potential in π-mesic atoms. (auth)

10032 FRIED-MARTIN CORRECTIONS FOR MESONIC AUGER TRANSITIONS. Russell, J. E. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 55: No. 5, 459-462(17 Mar 1975).

Using excited circular orbits of $\alpha\pi^-e^-$, αK^-e^- and αp^-e^- atoms as examples, it is shown that nuclear motion corrections to computed Auger rates can depend sensitively on the interpretation of the wave functions actually employed and also on the multipole order of the transition. (auth)

10033 STRONG INTERACTION EFFECTS IN HADRONIC ATOMS. Koch, H. (Karlsruhe Univ. (TH) (F. R. Germany)). pp 225-238 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974)

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Recent results on shifts and widths of energy levels in pionic, kaonic, antiprotonic, and Σ^--hyperonic atoms are discussed. A large amount of the data existing today on strong interaction effects in kaonic, and Σ^--hyperonic atoms is presented in the tables and compared with calculations. This comparison tries to give an impression of how much of the data is already understood and can be used to give information on physical properties of the systems involved. Besides the discussion of the strong interaction effects, a summary of other recent results on hadronic atoms is given, e.g., the π^- and K^- masses, the polarizability of the kaon, and the magnetic moments of the antiproton and the Σ^- hyperon. (auth)

10034 OPTICAL POTENTIALS FOR HADRONIC ATOMS. Wycech, S. (Institute of Nuclear Research, Warsaw (Poland)). pp 239-246 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Strong shifts of the electromagnetic levels in the hadronic (mainly kaonic) atoms and a description of these in terms of the optical potentials are discussed. Some problems and difficulties in the determination of the potentials from the elementary interactions are reviewed. Several theoretical attempts to deal with this question and various approximations are presented. At the moment there is no entirely satisfactory description of the data, partly because of poor knowledge of the elementary interactions below the hadron nucleon mass threshold. The conclusion is drawn that the atomic experiments are a good way to test the theoretical models, but to learn about the structure of the nuclear surface the processes of strong decay and decay products must be studied as well. (auth)

10035 REMARKS RELEVANT TO FINE STRUCTURE. Huang, K. N.; Hughes, V. W.; Lewis, M. L.; Mueller, R. O.; Rosenthal, H. (Yale Univ., New Haven, Conn. (USA). Dept. of Physics); Wu, C. S. (Columbia Univ., New York (USA). Dept. of Physics); Camani, M. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). pp 312-314 of Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The possibilities of measuring energy levels in two simple muonic atoms, muonic hydrogen (μ^-p) and the muonic helium atom ($\alpha\mu^-e^-$), are discussed. (auth)

10036 FORMATION OF PIONIC AND MUONIC ATOMS IN LIQUID HELIUM AND HYDROGEN. von Egidy, T.; Backenstoss, G.; Egger, J.; Hagelberg, R.; Harrlander, C. J.; Koch, H.; Povel, H. P.; Schwitter, A.; Tauscher, L. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 299-302 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

After stopping of muons in liquid hydrogen a delayed 8.12 ± 0.07 keV line and a 5495 ± 6 keV line were observed with Si(Li) and Ge(Li) detectors. The 8.12 keV line may correspond to the muonic transition from the molecular $p\mu d$ state to the $1s$-μ^3He state. The 5495-keV line is the binding energy of the fusion $p\mu d \rightarrow {}^3$He. An attempt was made to reproduce the measured absolute yields of muonic and pionic transitions in liquid helium with cascade calculations including external Auger effect, sliding transitions and for the pions nuclear absorption. The 3p-1s transition is more intensive than the 2p-1s transition. This cannot be achieved by cascade calculations including different formulas for nuclear absorption. (auth)

10037 NUCLEAR MATTER AND CHARGE DISTRIBUTIONS. Jackson, D. F. (Surrey Univ., Guildford (UK). Dept. of Physics). pp 323-333 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The theoretical and experimental methods currently available for the study of nuclear charge and matter distributions are listed and compared. The recent model-independent analyses of elastic electron scattering and muonic x-ray data are reviewed, followed by a review of the microscopic description of medium and high energy scattering of strongly interacting projectiles from nuclei in terms of an optical potential derived from the nuclear matter

distribution and a two-body interaction. An indication is given of which properties can be determined by the various measurements. (auth)

Collision Phenomena

Refer also to abstracts 9979–9980, 9983, 9985, 10013, 10601, and 10622–10623.

10038 QUASI-MOLECULAR APPROACH TO THE THEORY OF ION-ATOM COLLISIONS. Briggs, J. S. (Atomic Energy Research Establishment, Harwell, Eng.). pp 365-376 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The usefulness of recent calculations of the Hartree-Fock potential energy, electronic wavefunctions and orbital energies of a diatomic ion-atom collision pair in the description of elastic scattering and the excitation and radiative deexcitation of inner-shells is described. Good agreement with experimental data on K-shell vacancy production and x-ray emission indicates that the molecular promotion model of Fano and Lichten can be put on a quantitative basis. (5 figs, 25 refs) (auth)

10039 INVESTIGATION OF THE PROCESSES INVOLVED IN THE PRODUCTION OF NONCHARACTERISTIC X RAYS DURING ION BOMBARDMENT OF SOLID TARGETS. Cairns, J. A.; Marwick, A. D.; Chandler, P. J.; Briggs, J. S. (Atomic Energy Research Establishment, Harwell, Eng.). pp 377-387 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The role played by the projectile in generating both characteristic and non-characteristic x-rays during argon ion bombardment of silicon and silicon carbide is examined. This involves an investigation of the effect of projectile build-up in these targets, and some high resolution spectral examination of the ArL x-rays. It emerges that Ar yields Si collisions are mainly responsible for the non-characteristic x-rays; the dominant mechanism at the energy investigated is a double scattering process, although recoils also play a role in the Ar yields Si system. The differential cross-sections for non-characteristic x-rays produced during C yields C collisions have been measured over the energy range 40 yields 280 keV. This work demonstrates a gradual levelling off of these cross-sections and also highlights the appearance of x-rays having energy greater than the united atom limit, arising from a collision broadening effect. (6 figs, 18 refs) (auth)

10040 OBSERVATION OF THE UNITED CARBON–CARBON ATOM K-SHELL X-RAY BAND FOR INCIDENT CARBON ION ENERGIES OF 30 TO 2500 keV. Laubert, R. (New York Univ., NY). pp 389-396 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The centroid energy and x-ray cross section for the non-characteristic carbon-carbon x-ray band produced by 30-2500 keV carbon ions incident on thick solid carbon targets are reported. The double collision assumption is tested for the production of these non-characteristic x-rays and it is found that, for 250 keV carbon ions, the experimental results are consistent with this assumption. (5 figs, 14 refs) (auth)

10041 CROSS SECTIONS FOR THE PRODUCTION OF X RAYS FROM HEAVY ION COLLISIONS AT MeV ENERGIES. Bell, F.; Betz, H. D. (Univ., Munich). pp 397-406 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF 730958-P1.

X-rays which are emitted in heavy ion collisions have been systematically investigated. Absolute cross-sections, sigma, are reported for the production of Cl-K x-rays in collisions of 30- to 120-MeV chlorine ions with various thin solid targets ranging from Z/sub T/ equals 6 (carbon) to Z/sub T/ equals 92 (uranium). Surprisingly pronounced oscillations are found in the dependence of sigma on Z/sub T/; in contrast to general expectations these oscillations (i) are very sharp, (ii) tend to increase with increasing energy of the projectile, and (iii) can not, at present, be satisfactorily explained by Coulomb excitation or molecular orbital considerations. Furthermore, we present some detailed results on the newly discovered phenomenon of radiative electron capture (REC); the mechanism to produce REC, line position and width of REC are discussed. (5 figs, 13 refs) (auth)

10042 DE-EXCITATION OF SULFUR L-SHELL VACANCIES PRODUCED IN ION-ATOM COLLISIONS IN SOLIDS. Bhalla, C. P. (Inst. for Atomic and Molecular Physics, Amsterdam). pp 407-419 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The inherent difficulties in obtaining relative populations of electronic defect configurations (and charge states) are presented for a 100 keV sulphur projectile traversing through a solid. It is concluded that this type of information cannot be deduced, as yet, from x-ray spectra of sulphur projectiles. Theoretical transition energies, transition rates and fluorescence yields are presented for sulphur with single 2p and multiple M vacancies. (auth)

10043 APPLICATION OF A CAUCHOIS SPECTROMETER TO MEASUREMENT OF ION-EXCITED Ni K alpha SATELLITE SPECTRA. Jundt, F. C. (Univ. of Rochester, NY); Nagel, D. J. pp 447-460 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

A transmission crystal (Cauchois) spectrometer was used for the first time for high resolution measurements of ion-excited x-rays. Ni K alpha satellite spectra produced in collisions of 61-MeV Ni ions with a Ni target showed that the simply-constructed instrument is useful for high-energy atomic collision studies. Dependence of measured and calculated satellite energies on atomic number was examined. K alpha satellite peak spacings computed from Hartree–Fock-Slater theory were found to be significantly smaller than experiment for elements Ca–Ni. The measured Ni K alpha spectrum contains structure not found in spectra from lighter atoms. (7 figs, 25 refs) (auth)

10044 CHARGE STATE DEPENDENCE OF Si X-RAY PRODUCTION IN SOLID AND GASEOUS TARGETS BY 40 MeV OXYGEN ION IMPACT. Mowat, J. R.; Appleton, B. R.; Biggerstaff, J. A.; Datz, S.; Moak, C. D.; Sellin, I. A. (Oak Ridge National Lab., TN). pp 461-467 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The yield of silicon K x rays induced by 2.5-MeV/amu oxygen ions in gaseous (SiH_4) and amorphous solid targets was studied. For a gas density 7.4×10^{14} cm^{-2} the yield increases approximately exponentially with the charge state q of the projectile in the region q equals 6, 7, 8. A similar, but smaller, trend is found for a 7 mu g/cm^2 solid target. At this beam energy the most probable oxygen charge state emerging from a solid Si target is O^{7+}. The x-ray yield from the solid is in accord with the emergent charge state. (auth)

10045 ELECTRONIC EXCITATION IN COLLISIONS OF FAST PROTONS AND HYDROGEN ATOMS WITH NO, N_2O, CO_2, AND OCS. Birely, J.H.; Johnson, P.A. (Chemistry and Physics Laboratory, The Aerospace Corporation, El Segundo, California 90245). J. Chem. Phys. 62: No. 12, 4854-4858 (15 June 1975).

Analyses of radiation in the 115–850 nm range produced by collisions of 10–25 keV H^+ and H with NO, N_2O, CO_2, and OCS under thin target conditions have been carried out. In agreement with our earlier observations for CO_2, the most prominent features for the polyatomic targets are emitted by excited parent molecule ions. Except in the case of OCS, for which weak CO^+ ($B\,^2\Sigma^+ - X\,^2\Sigma^+$) bands were detected, the cross sections for dissociative excitation to yield diatomic fragments are extremely small. These observations in conjunction with results obtained elsewhere for other projectile ions provide further evidence that in the competition among allowed excitation channels, details of the electronic structure of the collision partners override energy considerations. For an NO target, the NO^+ ($A\,^1\Pi - X\,^1\Sigma^+$) bands are observed, and, for all of the molecules studied, atomic lines owing to dissociative excitation are prominent in the spectra. (auth)

10046 PENNING IONIZATION OF D BY He METASTABLES. Neynaber, R.H.; Magnuson, G.D. (IRT Corporation, San Diego, California 92138). J. Chem. Phys. 62: No. 12, 4953-4954 (15 June 1975).

A merging-beams technique has been used to study the Penning ionization reaction $He^* + D \rightarrow He + D^+ + e$ over a range of interaction energy W from 0.1 to 10 eV. (AIP) (auth)

10047 RESONANT STRUCTURE IN ELECTRON IMPACT EXCITATION OF CO NEAR THRESHOLD. Swanson, N.; Celotta, R.J.; Kuyatt, C.E.; Cooper, J.W. (National Bureau of Standards, Washington, D.C. 20234). J. Chem. Phys. 62: No. 12, 4880-4888 (15 June 1975).

Electron impact excitation functions of numerous states in CO have been measured at 45° scattering angle with resolutions of 16–23 meV FWHM. The decay peak of the 10.04 eV resonance can be seen in the

results for the $a\,^3\Pi$, $a'\,^3\Sigma^+$, and $A\,^1\Pi$ vibrational levels. There was no evidence of resonant excitation of the $a'\,^3\Sigma^+$ state near 8 eV as suggested by Newton and Thomas. Excitation functions of the $b\,^3\Sigma^+$, $B\,^1\Sigma^+$, $C\,^1\Sigma^+$, $c^3\Pi$, and $E\,^1\Pi$ states, and a previously unobserved state at 11.26 eV show numerous sharp resonances in the first few eV above threshold. Energy loss spectra in the 8–14 eV loss region show peaks corresponding to known states as well as to unidentified states. No sign of the metastable state at about 9.5 eV seen by Wells, Borst, and Zipf could be detected in direct excitation, but an indirect excitation process involving the $A\,^1\Pi$ state is consistent with the data. (auth)

10048 SEMICLASSICAL CALCULATIONS OF VIBRATIONAL ENERGY TRANSFER: COMPARISON OF THE HARMONIC AND THE MORSE OSCILLATOR IN COLLINEAR AND PERPENDICULAR COLLISIONS WITH A STRUCTURELESS ATOM. Schinke, R.; Toennies, J.P. (Max-Planck-Institut für Strömungsforschung, 34 Göttingen, Germany). J. Chem. Phys. 62: No. 12, 4871-4879 (15 June 1975).

Collinear and perpendicular collisions of an atom with a diatom are considered using both the harmonic and the Morse molecular binding potentials. A uniform semiclassical approximation is used to calculate individual vibrational transition probabilities and averaged energy transfers. Differences in individual probabilities and in averaged energy transfers in collinear as well as in perpendicular collisions depend strongly on the reduced mass ratio m. For a large m, the discrepancy between the harmonic and the Morse oscillator is large, while with decreasing m the agreement becomes progressively better. In the collinear geometry more energy is transferred to the harmonic oscillator than to the Morse oscillator, while the reverse holds in the perpendicular geometry. These effects are explained qualitatively by studying the time dependence of the oscillator energy during a classical trajectory. (auth)

10049 PHENOMENOLOGICAL TREATMENTS OF CROSS SECTIONS FOR PROTON AND HYDROGEN IMPACT BELOW 1 keV ON MOLECULAR NITROGEN. Porter, H.S.; Szydlik, P.P.; Green, A.E.S. (Department of Physics and Astronomy, University of Florida, Gainesville, Florida 32611). J. Chem. Phys. 62: No. 12, 4605-4614 (15 June 1975).

An analytic independent-particle model is used to construct static potentials to describe the interaction of hydrogenlike ions with atoms and molecules. Parameters of the ion–atom potential are determined from *ab initio* total energy minimization procedure. The elastic scattering of He^+ from Ne and Ar is investigated as a test case and comparison is made with experiment. The model is then used in conjunction with low energy H^+–N_2 experimental data to construct differential and total cross sections for the scattering of protons and hydrogen in the energy range 10 eV to 1 keV from molecular nitrogen. Analytic forms are used to parametrize these cross sections to facilitate their use in the calculation of energy deposition by protons and hydrogen atoms in atmospheric gases. (auth)

10050 REACTIONS OF DIATOMIC RARE-GAS IONS WITH RARE-GAS ATOMS FOR PRIMARY-ION ENERGIES BELOW 50 eV. Maier, W.B. II (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). J. Chem. Phys. 62: No. 12, 4615-4622 (15 June 1975).

Reactions of He^+_2, Ne^+_2, and Ar^+_2 with rare-gas atoms have been studied for center-of-mass energies, E_0, below 40 eV. Electron transfer, collision-induced dissociation of the primary ion, and ion transfer have all been observed. At $E_0=1$ eV, electron transfer sometimes occurs with very large ($\sim$50 Å^2) cross sections; however, sometimes the cross section for electron transfer is small. The observed cross sections for electron transfer increase as E_0 is decreased. Collision-induced dissociation of the primary ion occurs with maximum cross sections of 1.5–25 Å^2; these cross sections fall off as E_0 is lowered below some value. The cross sections for the collision-induced dissociation of He^+_2 are observed to be smaller than the cross sections for the collision-induced dissociation of Ne^+_2 and Ar^+_2. Ion transfer is observed in only two cases: $Ar^+_2+Ne \rightarrow ArNe^+ + Ar$ and $Ne^+_2+He \rightarrow NeHe^+ + Ne$; the cross sections for these reactions increase as E_0 is lowered. (auth)

10051 *A priori* LOW TEMPERATURE VIBRATIONAL RELAXATION RATES FOR He–H_2. McGuire, P.; Toennies, J.P. (Max-Planck-Institut für Strömungsforschung, 34 Göttingen, West Germany). J. Chem. Phys. 62: No. 12, 4623-4627 (15 June 1975).

The recently developed coupled-states approximation has been applied to the He–H_2 system for the calculation of the vibrational de-excitation cross sections $nj=10 \rightarrow 0j'$ ($j'=0,2,4,6,8,10$) for energies from threshold up to $E_{total} = 0.99$ eV. Computations have been carried out for three potential surfaces: (1) Krauss–Mies, (2) Gordon–Secrest, and (3) Gordon–Secrest, modified to include the long-range attraction. The low temperature relaxation rates for each surface are reported and compared to the experimental data from the stimulated Raman technique. $V \rightarrow R$ energy transfer is found to be very important in the vibrational relaxation process and the modified Gordon–Secrest surface gives the best fit to the experimental data. (auth)

10052 ELECTRON CORRELATION EFFECTS NEAR THRESHOLD FOR ELECTRON-IMPACT IONIZATION OF HELIUM. Spence, D. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. A 11: No. 5, 1539-1542 (May 1975).

Using a modification of the trapped-electron technique, we have measured the total intensity of electrons inelastically scattered from helium as a function of both incident and final energies near the ionization threshold. We find that a "cusp," which appears in the scattered electron intensity at the ionization threshold for electrons of near-zero final energy, decreases in visibility as the energy of the scattered electrons increases. For scattered-electron energies greater than about 2.0 eV, the intensity is smooth through the ionization threshold. The physical reason for the cusp is the formation of states with two excited and strongly correlated electrons. These experiments define the range of excess energies above the ionization threshold for which correlation effects are important, and hence measure the energy range of validity of the Wannier law of threshold ionization. (auth)

10053 TWO-PHOTON IONIZATION OF THE NEUTRAL ARGON ATOM. Pindzola, M.S.; Kelly, H.P. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. A 11: No. 5, 1543-1551 (May 1975).

The two-photon ionization cross section for the neutral argon atom is calculated. A double perturbation expansion in the Coulomb correlations and the atom–radiation-field interaction is made. Contributions from intermediate states are obtained by direct summation over Hartree-Fock bound and continuum single-particle states. The effects of electron correlations and photon-radiative corrections are investigated. Comparison is made with previous theoretical methods. (auth)

10054 MODIFIED BORN MODEL FOR EXCITATION OF ATOMS BY ELECTRONS. Junker, B.R. (Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). Phys. Rev. A 11: No. 5, 1552-1559 (May 1975).

A modification of the Born approximation is employed to compute the differential cross section for excitation of the 2*s* and 2*p* states of hydrogen by electrons at energies of 100, 200, 500, 1000, and 1500 eV. The modification consists of expanding the exact wave function of the total Hamiltonian in terms of Coulomb functions as opposed to plane waves in the normal Born approximation. The differential cross sections thus obtained are orders of magnitude larger at back angles and thus in much better agreement with experiment. (auth)

10055 *L*-SHELL IONIZATIONS OF Au, Bi, and U IN PROTON AND HELIUM-ION IMPACT. Tawara, H. (Nuclear Engineering Department, Kyushu University, Fukuoka, Japan); Ishii, K.; Morita, S.; Kaji, H.; Shiokawa, T. Phys. Rev. A 11: No. 5, 1560-1570 (May 1975).

The x-ray production cross sections of the total *L* shell and of the $L\alpha$, $L\beta$, $L\gamma$, Ll, and $L\eta$ transitions have been measured for Au, Bi, and U for proton impact over the energy range from 1.0 to 4.5 MeV and for $^3He^+$ impact from 3.0 to 9.0 MeV. The measured x-ray production cross sections and the ratios of the x-ray production for various transitions are compared with calculations based on the plane-wave Born approximation (PWBA) and the binary-encounter approximation (BEA). Generally, the PWBA is in better agreement with the observed results. Various correction factors to these simplified theories are also estimated and discussed. The ratios of the x-ray production for proton impact to that for helium-ion impact, at equal velocities, deviate systematically from the theoretical Z_1^2 dependence. This behavior is discussed in terms of the nuclear repulsion for the projectile, the change in binding energy of the target electrons, and the polarization of electron orbit. It is shown that the observed total *L*-shell ionization cross sections for various elements taken from the present and other works can be represented by a single smooth curve, which at higher energies is in good agreement with the BEA curve of Garcia derived for the *K*-shell ionization, though the experimental values at lower energies are considerably higher than the theoretical predictions. (auth)

10056 ELECTRON EXCITATION CROSS SECTION OF THE He $2\,^1S$ STATE FROM DIFFRACTION LOSSES IN A He-Ne GAS LASER. Ferendeci, A.M. (Physics Department, Cekmece Nuclear Research and Training Center, P.K.1, Havalani, Istanbul, Turkey). Phys. Rev. A 11: No. 5, 1576-1582 (May 1975).

Diffraction losses in the optical cavity of a He-Ne gas laser are experimentally studied for the TEM_{q00}, TEM_{q10}, and TEM_{q01} transverse modes by changing the size of a square aperture placed in front of one of the laser mirrors. By measuring the threshold oscillation current I_t as a function of the aperture size $2a$, the total losses in the cavity can be determined. These losses are related to the electronic excitation rate of the He $2\,^1S$ metastable state at the threshold of oscillation current and are used to evaluate the inelastic electron excitation cross section of the He $2\,^1S$ state. The experimentally determined cross section is in very close agreement with the published absolute cross-section measurements. (auth)

10057 EFFECTS OF ANISOTROPIC ELECTRON-ION INTERACTIONS IN ATOMIC PHOTOELECTRON ANGULAR

DISTRIBUTIONS. Dill, D. (Department of Chemistry, Boston University, Boston, Massachusetts 02215); Starace, A.F.; Manson, S.T. Phys. Rev. A 11: No. 5, 1596-1606 (May 1975).

The photoelectron asymmetry parameter β in *LS* coupling is obtained as an expansion into contributions from alternative angular-momentum transfers j_t. The physical significance of this expansion of β is shown to be that (1) the electric-dipole interaction transfers to the atom a characteristic single angular momentum $j_t = l_0$, where l_0 is the photoelectron's initial orbital momentum, whereas (2) angular-momentum transfers $j_t \neq l_0$ indicate the presence of anisotropic (i.e., term-dependent) interaction of the outgoing photoelectron with the residual ion. For open-shell atoms the photoelectron-ion interaction is generally anisotropic; photoelectron phase shifts and electric-dipole matrix elements depend on both the multiplet term of the residual ion and the total orbital momentum of the ion-photoelectron final-state channel. Consequently, β depends on the term levels of the residual ion and contains contributions from all allowed values of j_t. These findings contradict the independent-particle-model theory for β, which ignores the final-state electron-ion interaction and to which our expressions reduce in the limiting cases for which only $j_t = l_0$ is allowed, namely (a) spherically symmetric atoms (e.g., closed-shell atoms) and (b) open-shell atoms for which the electron-ion interaction is isotropic (e.g., very light elements). Numerical calculations of the asymmetry parameters and partial cross sections for photoionization of atomic sulfur are presented to illustrate the theory and to demonstrate the information on electron-ion dynamics that can be obtained from the theoretical and experimental study of β for open-shell atoms. (auth)

10058 EXCITATION OF ATOMIC HYDROGEN TO THE $n=2$ STATES BY 15–200-keV PROTONS. Park, J.T.; Aldag, J.E.; George, J.M. (Physics Department, University of Missouri-Rolla, Rolla, Missouri 65401). Phys. Rev. Lett. 34: No. 20, 1253-1256 (19 May 1975).

Cross sections for the process $H^+ + H \rightarrow H^+ + H^*$ ($n=2$) are determined from the energy-loss spectra of 15–200-keV protons. After normalization at 200 keV to the Born approximation, the maximum value (1.07×10^{-16} cm^2 at 60 keV) lies below close-coupling calculations and above Glauber-approximation calculations. The agreement with low-energy (5–30-keV) data of others is very good. (auth)

10059 GENERALIZED OSCILLATOR STRENGTHS FOR THE IONIZATION OF HELIUM BY PROTONS, CALCULATED WITH THE CLASSICAL THREE-BODY COLLISION THEORY. Boesten, L. G. J. (Rijksuniversiteit, Utrecht, Netherlands); Bonsen, T. F. M.; Banks, D. J. Phys., B (London); 8: No. 4, 628-637 (11 Mar 1975).

Differential cross sections and generalized oscillator strengths $f_E(q)$ for ionization of helium by 100 and 300 keV protons have been calculated, using a classical three-body collision theory, in which the momentum transfer to the atomic nucleus has been eliminated. Comparisons are made with the results of the scaled first Born approximation and the binary encounter theory. The calculated generalized oscillator strengths depend upon the energy of the incident proton. There is a marked difference between the present results and the other two theories for small energy transfers. (auth)

10060 ELECTRON AND POSITRON SCATTERING BY HELIUM AND NEON. Bransden, B. H.; Hutt, P. K. (Durham Univ., Eng.). J. Phys., B (London); 8: No. 4, 603-611(11 Mar 1975).

New measurements of the total cross sections for positron scattering by helium and by neon are tested for consistency with a sum rule based on forward dispersion relations. The real parts of the forward scattering amplitudes are calculated and compared with recent theoretical predictions. Revised values of the real part of the forward scattering amplitude for electron scattering by helium are presented. (auth)

10061 ELECTRON SCATTERING AT A THRESHOLD ABOVE A RESONANCE: HELIUM. Herzenberg, A.; Ton-That, D. (Yale Univ., New Haven). J. Phys., B (London); 8: No. 3, 426-441 (21 Feb 1975).

Excitation of the lowest triplet state (2^3S) near threshold arises from interactions of short range, because of the electron-exchange needed to bring about the change of target spin. The short-range interaction is here described by the simplest possible R-matrix which reproduces the ^2S resonance observed about 0.5 eV below threshold (i.e., a simple pole term without a background). Only s-waves are considered. The observed singularity ("cusp") in the elastic differential cross section, and the observed nearly vertical onset of the inelastic cross section at threshold are accounted for if one includes the effect of polarization of the atom on a slow outgoing electron which has been scattered inelastically. (auth)

10062 DIRECT AND EXCHANGE PROCESSES IN ION-ATOM COLLISIONS. I. He^+–He. Brenot, J. C.; Pommier, J.; Dhuicq, D.; Barat, M. (Paris Univ., Orsay, France). J. Phys., B (London); 8: No. 3, 448-459(21 Feb 1975).

A time-of-flight spectrometer is described and is shown to have sufficiently good energy resolution to allow a detailed investigation of energy losses for scattered neutral particles. This method has been applied to the study of the exchange channels to complement the previous ion studies. The He^+–He results are discussed in the light of the quasi-molecular description of the collision mechanisms. (auth)

10063 DIFFERENTIAL CROSS SECTIONS FOR THE ELASTIC SCATTERING OF ELECTRONS BY NEON. Gupta, S. C.; Rees, J. A. (Univ. of Liverpool). J. Phys., B (London); 8: No. 3, 417-425(21 Feb 1975).

Measurements of the angular differential cross section for the elastic scattering of electrons in neon have been made for incident energies of 100 to 625 eV over an angular range 10 to 150 degrees. The observed relative differential cross sections for energies of 100 to 500 eV have been converted to an absolute scale by measuring differential scattering at each energy in 5 and 10% mixtures of neon in helium and using available cross section data for helium. Results are compared with other measurements and with recent calculations. Agreement with absolute measurements for small angles by Bromberg (J. Chem. Phys.; 61: 963-9 (1974)) is excellent. (auth)

10064 EXPERIMENTAL INVESTIGATION AND PHASE SHIFT ANALYSIS OF LOW-ENERGY ELECTRON–HELIUM SCATTERING. Andrick, D.; Bitsch, A. (Trier-Kaiserslautern Univ., Ger.). J. Phys., B (London); 8: No. 3, 393-410(21 Feb 1975).

The angular distribution of electrons scattered elastically from helium atoms has been measured in the energy range from 2 to 19 eV. The experimental data have been fitted by the partial wave formula to determine the scattering phase shifts. From these, absolute values of the differential and the total cross sections were computed. The accuracy of the measured shape of the angular distributions is better than 5%, of the absolute calibration between 20% at low and 5% at high energies. The discrepancy between earlier experiments and theoretical predictions is removed in favor of theory. (auth)

10065 PHASE-SHIFT AND DISPERSION-RELATION ANALYSIS OF ELECTRON ATOM SCATTERING. A Progress Report. McDowell, M. R. C. (Royal Holloway Coll., London). Comments At. Mol. Phys.; 4: No. 6, 147-156(1973).

The current status of phase-shift and dispersion-relation analysis of atomic scattering data is summarized. The results on helium suggest that the dispersion relation is satisfied. It is suggested that considerable uncertainty attaches to the published experimental total cross sections measured in transmission experiments, for both electron and positron impact, at moderate and high energies. (auth)

10066 MEASUREMENTS OF THE $(3p^2)^1D$ STATE OF H^- BY ELECTRON TRANSMISSION SPECTROSCOPY. Spence, D. (Argonne National Lab., IL). J. Phys., B (London); 8: No. 4, L42-L45(11 Mar 1975).

Using an electron transmission spectrometer, structures in the total cross section for e-H scattering are studied. The energy of the $(3p^2)^1D$ state of H^- is found to be 11.860 ± 0.030 eV above the ground state of atomic hydrogen. This result is compatible with measurements from ion-atom collision experiments and with structures observed in the 1s-2p excitation cross section, but is in significant disagreement with some theoretical predictions. (auth)

10067 ELASTIC AND INELASTIC SCATTERING OF 40 eV ELECTRONS FROM ATOMIC LEAD. Williams, W.; Trajmar, S. (Jet Propulsion Lab., Pasadena, CA). J. Phys., B (London); 8: No. 4, L50-L53(11 Mar 1975).

Differential and integral electron impact cross sections for elastic scattering and for the excitation of the first five states in lead were determined at 40 eV impact energy. The cross section measurements were placed on the absolute scale by normalizing to the optical f-value of the $6p7s\ ^3P_1$ transition which is the upper state for the 7229 Å, 4057 Å and 3639 Å laser emissions. The integral cross sections for elastic scattering ($6p^2\ ^3P_0$) and for the excitation of the $6p^2\ ^3P_1$, $6p^2\ ^3P_2$, $6p^2\ ^1D_2$, and $6p7s\ ^3P_0$ (+$6p7s\ ^3P_1$) states are: 44, 0.15, 1.5, 0.05 and 8.4×10^{-16} cm^2 respectively. (auth)

10068 DIFFERENTIAL CROSS SECTION FROM QUANTAL SOLUTIONS FOR EXCITATION OF H INTO 2p STATE IN H^+–H COLLISIONS. Kubach, C. (Univ., Paris); Sidis, V. J. Phys., B (London); 8: No. 4, 638-642(11 Mar 1975).

The calculation of the differential cross section for excitation of the 2p state of H in H^+–H collisions at an energy of 205 eV(CM)

is reported. The computational method consists in solving, using the Numerov algorithm, the set of quantal two-state close-coupled equations relative to the $2p\sigma_u$ and $2p\pi_u$ molecular states of H_2^+ in the perturbed stationary state approximation (Mott. Proc. Phil. Soc.; 27: 553-60 (1931)). Comparison is made with the experimental data of Houver et al. (J. Phys. B. Atom. Molec. Phys.; 7: 1358-69 (1974)) together with results of the common trajectory method of Gaussorgues et al. (J. Phys. B. Atom. Molec. Phys.; 8: 239-52 and 253-64 (1975)). The efficiency of the latter method is confirmed. (auth)

10069 VELOCITY DEPENDENCE OF TOTAL PENNING IONIZATION CROSS SECTIONS. Illenberger, E.; Niehaus, A. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). Z. Phys., B.; 20: No. 1, 33-41(1975).

The velocity dependence of the total Penning ionization cross sections is measured in the thermal relative velocity region, using a time of flight method. Curves are reported for the collision systems singlet He(2S)/Ar, Kr, Xe, N_2, Hg, triplet He(2S)/Ar, Kr, Xe, N_2, Hg, triplet Ne(P2,0)/Kr, Hg, and triplet Ar(P2,0)/Hg. In a qualitative discussion it is shown that all features of the measured curves may be explained within the frame of the theory of Penning ionization, allowing one to extract information on the physical quantities governing the process: on the interaction potential V(R) and on the transition probability W(R). A theoretical calculation for the triplet He(2S)/Ar system shows good agreement with our experimental curve. (auth)

10070 CHARGE EXCHANGE BETWEEN MULTIPLY CHARGED IONS AND ATOMS. Presnyakov, L.P.; Ulantsev, A.D. (P.N. Lebedev Physics Institute, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 11, 1320-1324 (May 1975).

An analysis is made of the capture of electrons by excited states of an ion in collisions of atoms with multiply charged ions ($Z \geq 10$). General expressions are obtained for the transition probabilities and cross sections of one-electron charge exchange and allowance is made for the strong coupling of the initial and final states of an atom + ion system. The capture cross section of an ion level with a binding energy exceeding the ionization potential of an atom is found to have two separate maxima along the energy scale. The total charge-exchange cross section in the range of energies of relative motion $1-10^5$ eV/nucleon is proportional to Z^2, where Z is the ion charge. The results of calculations are in quantitative agreement with the published experimental results. It is shown that the two-electron capture cross section is smaller than the one-electron cross section and that in the $Z \geq 10$ range an unstable excited state of an ion decays preferentially by the emission of radiation. (auth)

10071 CONFIGURATION INTERACTION STUDIES OF THE EXCITED STATES OF WATER. Winter, N.W. (Chemistry and Physics Laboratory, The Aerospace Corporation, El Segundo, California 90245); Goddard, W.A. III; Bobrowicz, F.W. J. Chem. Phys. 62: No. 11, 4325-4331 (1 June 1975).

We report the results of extensive configuration interaction studies on 16 excited states of water. These states can be accurately described as corresponding to excitation from one of the highest two molecular orbitals ($1b_1$ or $3a_1$) of the ground state into either the 3*s* or one of the three 3*p* Rydberg orbitals. The results provide the most accurate and consistent treatment of these states to date (within 0.1 eV for all known transitions) and form a reliable basis for the assignment of the photon and electron impact spectra of H_2O. (auth)

10072 ON j_z-CONSERVING COUPLED-STATES APPROXIMATION FOR MOLECULAR COLLISIONS. Choi, B.H.; Tang, K.T. (Department of Physics, Pacific Lutheran University, Tacoma, Washington 98447). J. Chem. Phys. 62: No. 11, 4568-4569 (1 June 1975).

Recently, McGuire and Kouri introduced the j_z-conserving coupled-states method for inelastic scattering between an atom and a diatomic molecule in order to reduce the dimension of coupled equations. In this letter the conditions under which that method might be expected to be valid are investigated. It is found that in cases where high values of j are involved, particularly if neither j nor j' is equal to zero, the results of the j_z-conserving method must be viewed with caution. (AIP)

10073 FORMAL THEORY OF ATOM–DIATOMIC MOLECULE REACTIONS. Mittleman, M.H. (Physics Department, The City College, City University of New York, New York, New York 10031). J. Chem. Phys. 62: No. 11, 4450-4454 (1 June 1975).

Low energy atom–diatomic molecule scattering is formulated in the adiabatic representation. Explicit care is taken to describe the scattering boundary conditions and the Pauli principle correctly. A set of coupled three-body equations is obtained for the nuclear motion. Coupling represents "hopping" from one electronic surface to another. The coupling operator is obtained by a generalization of a method previously used in atom–atom scattering. It has the property of vanishing when the reacting products are well separated and involves the previously introduced electron switching function and a new nuclear switching function. (auth)

10074 DISSOCIATION OF H_2^+ ION BY COLLISION-INDUCED VIBRATIONAL EXCITATION. Dastidar (Mullick), KR.; Barua, A.K. (Department of General Physics and X Rays, Indian Association for the Cultivation of Science, Calcutta 700032, India). J. Chem. Phys. 62: No. 11, 4373-4379 (1 June 1975).

Collision-induced dissociation of hydrogen molecular ion due to the vibrational excitation from ground vibrational state to the continuum of electronic ground state ($1s\sigma_g$) has been studied, using sudden approximation. In close encounters, the interaction between the nucleus of projectile and the two nuclei of molecular ion has been taken as the sum of two screened Coulomb-type interactions. Exact values for the ground vibrational state and quasiclassical wavefunctions for the continuum have been used. The angular distribution, energy distribution, and total vibrational dissociation cross section for fragments in a given excess energy range have been calculated with He, Ar, and Xe as projectiles. Cross sections for dissociation by Ar impact have been calculated for collision energies ranging from 3 to 50 keV, and for He and Xe at 10 keV. It is concluded that the electronic dissociation plays a dominant role even in the small excess energy region of dissociated fragments. (auth)

10075 RESONANCES IN THE COLLINEAR INELASTIC SCATTERING OF He BY H^+_2 BELOW THE REACTION THRESHOLD. Chapman, F.M. Jr.; Hayes, E.F. (Department of Chemistry, William Marsh Rice University, Houston, Texas 77001). J. Chem. Phys. 62: No. 11, 4400-4403 (1 June 1975).

Collinear quantum mechanical calculations are reported for the inelastic scattering of He by H^+_2 below the reaction threshold. The inelastic transition probability curves show a severe oscillatory behavior similar to that recently observed in reaction probability curves for this same system. Perturbation calculations and considerations of the channel phase shifts indicate that the resonance structure is caused by the existence of quasibound (resonance) states of HeH^+_2. A simple picture is presented which accounts for these quasibound states. (auth)

10076 DETERMINATION OF THE EFFICIENCY OF ELECTRON-IMPACT EXCITATION OF A METASTABLE 2^3S HELIUM LEVEL. Bogdanova, I.P.; Marusin, V.D. Opt. Spectrosc. (USSR) 38: No. 1, 108-109 (Jan 1975).

The excitation function for the metastable state 2^3S of helium has been measured. He was excited by an electron beam incident on a mixture of He and Cd vapor. The efficiency of excitation of the metastable He level was determined by measuring the variation in intensity of the Cd 441.6 nm line. (auth)

10077 EXCITATION OF *s* ELECTRONS IN INDIUM AND GALLIUM ATOMS. Nepiipov, E.I. Opt. Spectrosc. (USSR) 38: No. 1, 106-106 (Jan 1975).

Measurements are reported for the excitation functions of $4P_j$ levels of indium and gallium with electron impact excitation. (auth)

10078 EXCITATION OF $nsnp^6\ ^2S_{1/2}$ STATES IN COLLISIONS OF ALKALI ATOMS WITH ELECTRONS. Aleksakhin, I.S.; Bogachev, G.G.; Zapesochnyi, I.P. Opt. Spectrosc. (USSR) 38: No. 1, 107-107 (Jan 1975).

The excitation of *s* electrons of the external filled shells of K, Rb and Cs was studied by electron impact. The excitation functions for $nsnp^6\ ^2S_{1/2}$ states of these atoms were measured. (auth)

10079 STRONG VIOLATION OF ADIABATICITY IN SLOW ATOMIC COLLISIONS. Afrosimov, V.V.; Gordeev, Yu.S.; Zinov'ev, A.N.; Rasulov, D.Kh.; Shergin, A.P. (A. F. Ioffe Physico-technical Institute, USSR Academy of Sciences). JETP Lett. 21: No. 1, 11-12 (5 Jan 1975).

Transitions are observed between nonintersecting terms of a system of colliding particles, the distance between which is ~200 eV. The transition probabilities greatly exceed the probabilities estimated on the basis of the existing theoretical models. (auth)

Atomic Theory

Refer also to abstracts 10030, 10255, and 10569.

10080 DERIVATION OF THE EXTENDED HARTREE–FOCK EQUATIONS. I. A Simple Derivation Using Specified Variations. Mayer, I. (Central Research Inst. for Chemistry, Budapest). Acta Phys. Acad. Sci. Hung.; 37: No. 1-2, 39-52(1974).

A simple derivation of the spin projected extended Hartree–Fock equations is presented, which is considerably less tedious than the previously given derivation based on the generalized Brillouin theorem. A simple algorithm for the calculation of the coefficients A^a_b occurring in the equations is also described. (auth)

10081 ELECTRON DENSITY IN MØLLER–PLESSET THEORY. Pople, J.A.; Seeger, R. (Carnegie-Mellon University, Department of Chemistry, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 62: No. 11, 4566-4566 (1 June 1975).

The Møller–Plesset theorem states that, for the electronic Hamiltonian in the form $H = \Sigma_p F_p + V$, where the eigenfunctions of F_p are the Hartree–Fock molecular spin orbitals and the eigenvalues are the one-electron energies, by treating V as a perturbation the first-order term in the expansion of the electron density vanishes. In spite of this, some one-electron properties are not given at the H–F level. This note presents the expression for the second-order correction to the electron density. (AIP)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

10082 UNSTEADY HYDROMAGNETIC BOUNDARY LAYER FLOW INDUCED BY TORSIONAL OSCILLATIONS OF A DISK. Debnath, L. (East Carolina Univ., Greenville, NC). Nuovo Cim., 25B: No. 2, 711-729(11 Feb 1975).

A study is made of the unsteady hydromagnetic boundary layer flow induced by the torsional oscillations of an infinite disk in an electrically conducting rotating fluid in the presence of a uniform magnetic field. Some qualitative and quantitative information is obtained about the structure of the steady and the unsteady velocity field; the existence of the hydrodynamic Rayleigh layer, the Ekman–Hartmann boundary layer, and the Stokes–Ekman–Hartmann boundary layer with their physical implications; the total transient time required for the establishment of quasi-steady hydromagnetic boundary layers; the hydromagnetic Ekman suction velocity and its importance; and the significant interaction of the electromagnetic and Coriolis forces. It is shown that the rapid attainment of the quasi-steady Ekman–Hartmann and the Stokes–Ekman–Hartmann boundary layers and the striking properties of the Ekman suction velocity appear to play a distinctive role in the hydromagnetic spin-up mechanism. Special attention is given to the physical interpretation of the mathematical results obtained. The significant effects of the imposed magnetic field on the flow phenomena were also investigated. (6 figures) (auth)

PHYSICS (HIGH-ENERGY)

10083 (CONF-740713) PROCEEDINGS OF THE XVII INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS, LONDON, ENGLAND, JULY 1974. Smith, J. R. (ed.). (International Union of Pure and Applied Physics, London (UK); Science Research Council, London (UK)). 1974. 923p. Science Research Council, Rutherford Lab., Chilton, Eng.

Separate abstracts are prepared for the 131 papers presented at the conference. Many of the presented papers consisted of review talks since 1110 papers had been submitted. The material presented was organized under the following major themes: strong interactions at high energy; resonance physics; weak interactions and theories unifying weak and electro-magnetic interactions; lepton-lepton and lepton-hadron interactions; reactions involving large transverse momentum. (UK)

For abstracts of individual papers see: 9009, 10084, 10086–10096, 10103–10114, 10126–10154, 10178–10181, 10203, 10217–10226, 10254–10259, 10268–10291, 10310–10314, 10324–10331, 10347–10348, 10378, 10394–10397, 10406, 10416, 10645, 10654–10661, and 10698.

10084 (CONF-740713-, pp VI.1-VI.16) PRESENT TRENDS IN PARTICLE PHYSICS. Fubini, S. CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

In this summary talk of the XVII International Conference on High Energy Physics. London. (1974) the lecturer discusses the most important theoretical and experimental trends which emerged from the conference. These include: spontaneous symmetry breaking; spontaneously broken gauge invariance and unified field theories; supersymmetries; small distance behaviour; e^+e^- annihilation; quarks and partons; fundamental length in particle physics; progress in high energy hadron phenomenology. (UK)

Particle Interactions and Properties (Experimental)

10085 (COO-1195-324) ANNUAL PROGRESS REPORT. (Illinois Univ., Urbana (USA). Dept. of Physics). Mar 1975. Contract AT(11-1)-1195. 41p. Dep. NTIS $5.25.

Experimental research on strong, electromagnetic, and weak interactions is summarized. A list of publications is included. (JFP)

Electromagnetic

10086 (CONF-740713-, pp IV.3-IV.5) OBSERVATION OF THE REACTIONS $e^+e^- \to e^+e^-$, $e^+e^- \to \gamma\gamma$, AND $e^+e^- \to \mu^+\mu^-$ AT A CENTER OF MASS ENERGY OF 5.2 GeV. Geron, B. L.; Crawford, J. F.; Hughes, E. B. (Stanford Univ., CA). 1974.

Fron 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Initial results from an experimental study of the reactions $e^+e^- \to e^+e^-$, $e^+e^- \to \gamma\gamma$ and $e^+e^- \to \mu^+\mu^-$ at the 2.6 GeV electron-positron storage ring (SPEAR) at the Stanford Linear Accelerator Center are reported. The purpose of this experiment was to test the validity of quantum electro-dynamics (QED) for large values of the square of the invariant four momentum transfer q^2 by measuring cross sections for the above reactions at angles close to 90°, relative to Bhabha scattering 3.7°. The experimental apparatus consisted of two identical spectrometers mounted in a collinear configuration about the beam interaction region. The principles used to determine the events which were accepted as candidates for each of the three reactions are discussed. The observed numbers of events and the numbers expected from QED, for the three reactions, together with the principal corrections and errors are tabulated. It is concluded that the rates observed in the experiment for the three reactions are fully consistent with the predictions of QED. (UK)

10087 (CONF-740713-, pp IV.6-IV.9) DETAILED STUDY OF EXCLUSIVE AND INCLUSIVE (e^+e^-) INDUCED PROCESSES IN THE ENERGY RANGE 1.2 to 3.0 GeV. Bernardini, M.; Bollini, D.; Brunini, P. L.; Massam, T.; Monari, L.; Palmonari, F.; Rimondi, F.; Zichichi, A. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The results of a study of 26,208 events produced in (e^+e^-) reactions ($e^+e^- \to e^+e^-$, $e^+e^- \to \mu^+\mu^-$, $e^+e^- \to h^+h^-$, $e^+e^- \to h^+h^-$ + anything) in the energy range from 1.2 to 3.0 GeV are reported. Analysis of the $e^+e^- \to e^+e^-$ reaction gave an accurate check of QED, the energy dependence of the process followed the expected QED behaviour within ±2%. Analysis of the $\mu^+\mu^-$ events allowed a check of the electromagnetic μ-e universality to ±4%. Assuming μe universality the data gave a check of crossing symmetry for QED to ±1%. The $e^+e^- \to h^+h^-$ reaction gave values of the electromagnetic form factors for the charged pseudoscaiar mesons in the timelike region 1.44 to 9.00 GeV^2. The angular distribution of the produced hadrons were studied in the reaction $e^+e^- \to h^+h^-$ + anything. All events with more than two tracks at all machine energies were analysed for range distribution. The analysis of the four track events yielded the exclusive cross sections $\sigma(e^+e^- \to 4\pi^\pm)$. Results are shown graphically and their significance with respect to the problem of $\rho'' \to 4\pi^\pm$ is discussed. The problem of deriving the total hadronic annihilation cross section by use of a model is discussed. (UK)

10088 (CONF-740713-, pp IV.10-IV.13) RECENT EXPERIMENTAL RESULTS AT ADONE. Felicetti, F. (Laboratori Nazionali, Frascati, Italy). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Recent experimental results at ADONE are reported. The cross section obtained from new data on the reaction $e^+e^- \to \pi^+\pi^-\pi^0\pi^0$ is shown. The results of an experiment on the relevant problem of the fraction of energy which goes into neutral particles in the reaction $e^+e^- \to$ many hadrons are discussed. The process $e^+e^- \to e^+\gamma e^-\gamma \to e^+e^-X$, X = hadronic state, has also been investigated, the equivalent mass of the hadronic system being measured with counters tagging the two final state electrons. Two events compatible with $\epsilon^0(660)$ production have been observed $e^+e^- \to e^+e^-\epsilon^0 \to \pi^+\pi^-$ from which the $\gamma\gamma$ width of $\epsilon^0(660)$ has been obtained to be $= 9.6^{+12.8}_{-6.0}$ KeV and one event was observed in the γ' mass region $e^+e^- e^+e^-$, $e^+e^- \to \ldots$. Depending on the evaluation evaluation of the non resonant contribution of $\gamma\gamma$ many hadrons, the value $\Gamma_{\gamma,\gamma\gamma} = 11^{+4}_{-3}$ KeV is obtained if the event comes from $\gamma\gamma \to \gamma'$; alternatively the upper limit $\Gamma_{\gamma,\gamma\gamma} \leq 33$ KeV (95% confidence level) is obtained if the event originates from a non resonant reaction $\gamma\gamma \to$ many hadrons. (UK)

10089 (CONF-740713-, pp IV.13-IV.16) INCLUSIVE REACTIONS OF $e^+e^- \to$ HADRONS. O'Neil, G. K. (Princeton Univ., NJ). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

First preliminary results are reported from an experiment just being completed at SPEAR to measure the inclusive reaction $e^+e^- \to$ hadrons. The principle characteristics of the experiment are outlined. The information from the shower counters, hadron filters, and cerenkov counter has been used to identify the $e^+e^- \to e^+e^-$ and $e^+e^- \to \mu^+\mu^-$ events in the data sample. It was found that the collinearity, coplanarity, and ratio of e^+e^- to $\mu^+\mu^-$ final states agree within statistics to QED. The integral momentum distribution of charged hadrons is shown. From initial analysis of a small part of the total data good evidence was obtained that the K/π ratio increases as the momentum increases. Multiplicity results are shown for two beam energies: 1.9 GeV, average multiplicity 4.03; 2.4 GeV, average multiplicity 4.5. (UK)

10090 (CONF-740713-, pp IV.57-IV.59) EXPERIMENTAL TESTS OF SCALING OF THE PROTON ELECTROMAGNETIC STRUCTURE FUNCTIONS. Bodek, A. (Massachusetts Inst. of Tech., Cambridge); Breidenbach, M.; Dubin, D. L.; Elias, J. E.; Friedman, J. I.; Kendall, H. W.; Poucher, J. S.; Riordan, E. M.; Sogard, M. R.; Coward, D. H.; Sherden, D. J. 1974.

From 17th international conference of high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The structure functions W_1 and W_2 and the longitudinal and transverse virtual photo-absorption cross sections σ_T and σ_L have been extracted from deep inelastic electron-proton scattering cross sections that were measured in two experiments at the Stanford Linear Accelerator Center (SLAC). In this article, emphasis is placed on tests of scaling $2MW_1$, νW_2 and νR where $R = \sigma_T/\sigma_L$, M is the proton mass and ν = initial energy of scattered

electrons (E) - final energy (E'). Using inelastic e-d cross-sections, R for the neutron and R for the deuteron were found to be equal to R for the proton, within the statistical errors. Recent measurements of the neutron to proton cross-section ratio, σ_n/σ_p, have extended the earlier studies to higher values of Q^2 and lower values of $\omega(\omega = 2M\nu/Q^2)$. The quantity σ_n/σ_p falls monotically with decreasing ω but the values still lie above the quark model lower bound of 0.25. (UK)

10091 (CONF-740713-, pp IV.60-IV.61) PRELIMINARY RESULTS FROM A RECENT EXPERIMENT ON INCLUSIVE DEEP INELASTIC SCATTERING. Atwood, W. B.; Bloom, E. D.; Cottrell, R. L. A.; Destaebler, H.; Mestayer, M.; Prescott, C. Y.; Rochester, L. S.; Stein, S.; Taylor, R. E.; Trines, D. (Stanford Linear Accelerator Center, CA). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Recent experiments at SLAC are reported to measurements of single-arm deep inelastic electron scattering cross sections from liquid hydrogen and deuterium targets. Investigations at large angles, 50° and 60°, were made using the 1.6 GeV spectrometer with a new counter system designed to detect electrons. Additional measurements in kinematic regions covered in previous experiments have been made using the 20 GeV spectrometer system. Cross sections for the two signs of incident particle were obtained in the 20 and 1.6 GeV spectrometers. Data taken at several values of W and Q^2 are shown. The ratio of the cross sections for positrons and electrons scattering is shown. No significant difference is seen between e^+ and e^- cross sections over the range of Q^2 and this is an encouraging indication that one-photon processes play a dominant role in deep inelastic scattering. These results may also have implications for models which speculate on the existence of new short range direct lepton-hadron interactions. (UK)

10092 (CONF-740713-, pp IV.65-IV.71) FINAL-STATE FEATURES IN DEEPLY INELASTIC ELECTRO- AND MUOPRODUCTION. Heusch, C. A. (Univ. of California, Santa Cruz). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A progress report is given on experiments covering final-state features in deeply inelastic electro and muoproduction covering the points: (1) What happens to the final-state hadrons as the exchanged photon becomes more massive (Q^2 increases)? (2) Do individual final-state channels account significantly for global features observed (like, for instance, $R = {}^{\sigma}L/\sigma_T$ and the forward charge ratio n_+/n_-)? (3) Do final-state features favor any particular model in a decisive way? (4) What experimental progress is there in the lepto-production of hadrons? Prominent features reported are summarized. (LBS)

10093 (CONF-740713-, pp IV.72-IV.74) REVIEW OF INCLUSIVE PION ELECTROPRODUCTION. Perl, M. L. (Stanford Linear Accelerator Center, CA). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

This review is based on four papers presented to the XVII International Conference on High Energy Physics. London. (1974) (Dakin et al. Electroproduction on hydrogen and deuterium using spark chambers, (Paper 160). Bunnel et al. Muonproduction on hydrogen using a streamer chamber, Papers 207, 208, 209. Eckardt et al. Electroproduction on hydrogen using a streamer chamber, (Paper 392). Bebek et al. Electroproduction on hydrogen and deuterium using a double arm spectrometer, (Paper 575). The incident lepton energies ranged from 7 to 20 GeV. No inclusive electroproduction or muonproduction data was available at higher energies. Inclusive distributions (ϕ, x and p_t dependence) and π^+/π^- production ratio in the virtual photon fragmentation region are discussed. (UK)

10094 (CONF-740713-, pp IV.75-IV.76) INCLUSIVE ELECTROPRODUCTION OF FORWARD PROTONS FROM NEUTRON AND PROTON TARGETS. Bebek, C. J.; Brown, C. N.; Herzlinger, M.; Holmes, S.; Lichtenstein, C. A.; Pipkin, F. M.; Raither, S.; Sisterson, L. K. (Harvard Univ., Cambridge, MA). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

New measurements are reported of the inclusive electroproduction reactions $e^- + (p,n) \rightarrow e^- + p +$ anything and of the exclusive reactions $e^- + (p,n) \rightarrow e^- + (\pi^+,\pi^-) + (n,p)$ carried out at the Wilson Synchrotron Laboratory at Cornell University. Data were taken with both deuterium and hydrogen at the (W,Q^2) points (2.15 GeV, 1.2 GeV^2), (2.15, 4.0) and (3.11, 1.2) and with hydrogen only at the additional points (2.15, 2.0), (2.67, 3.4) and (3.11, 1.7). Two magnetic spectrometers were used to detect the scattered electron and hadron. A combination of Cerenkov counters, shower counters and time of flight identified the electrons, pions, kaons and protons. The electroproduction data were treated as photoproduction by a virtual photon of mass $-Q^2$, energy ν and polarization parameter ϵ. It is shown that the invariant structure function for protons from a neutron target is only slightly less than that for protons from a proton target, the invariant structure function varies little with Q^2 at fixed W, and the invariant structure function decreases rapidly with W at fixed Q^2 for $x' > 0$. The value of the pion electromagnetic form factor derived from the data using the dispersion theory of Berends (Phys. Rev.; D_1: 2590 (1970)), (a) for no isoscalar component and (b) for isoscalar component given by $R = 1 - 0.817\sqrt{-t}$ is shown graphically. (UK)

10095 (CONF-740713-, pp IV.76-IV.78) INELASTIC COMPTON SCATTERING AND INCLUSIVE PHOTOPRODUCTION OF γ, π^0, AND ETA^0. Caldwell, D. O.; Cumalat, J. P.; Eisner, A. M.; Elings, V. B.; Kendall, B. N.; McPharlin, T. P.; Morrison, R. J.; Murphy, F. V.; Worster, B. W. (Univ. of California, Santa Barbara). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

High energy photons from a hydrogen target bombarded by a 21-GeV bremsstrahlung beam at SLAC have been detected in an 88-counter lead-glass array, arranged in two vertically separated stacks. Because γ-γ coincidences could be measured, the experiment provides new information on inclusive γ, π^0, and η^0 photoproduction at high energies. A particular motivation for the experiment was to observe inelastic Compton scattering, in an attempt to measure the average charge of nucleon constituents. The π^0 photoproduction data are shown plotted for fixed values of transverse momentum (P_T). The single γ yield at four values of P_T is shown and also the yield after subtracting the contributions from $\pi^0 \rightarrow 2\gamma$ and $\eta^0 \rightarrow 2\gamma$. One explanation of the single photon excess seen is that the sort of interchange model term which fits the π^0 results could be present in inelastic Compton scattering. This $\bar{q}p \rightarrow qq\gamma$ sub-process, which actually measures photon rather than proton structure, is consistent with the P_T dependence of the data. (UK)

10096 (CONF-740713-, pp IV.79-IV.80) COMPARISON OF e^+-e^- DEEP INELASTIC SCATTERING AND WIDE-ANGLE BREMSSTRAHLUNG. Caldwell, D. O.; Cumalat, J. P.; Eisner, A. M.; Fancher, D. L.; McPharlin, T. P.; Morrison, R. J.; Murphy, F. V.; Risser, T. B.; Yellin, S. J. (Univ. of California, Santa Barbara). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Following a suggestion of Brodsky et al. (Phys. Rev.; D6: 2487 (1972)) a measurement of $(e^+ + p \rightarrow e^+ + \gamma + \ldots) - (e^- + p \rightarrow e^- + \gamma + \ldots)$ in the scaling region has been made to provide a strong test of the parton model and, if the model should prove valid, a definitive test of whether the constituents of the proton have fractional versus integral charge. Analysis of the results is in progress and at the moment the $e^+ - e^-$ difference appears to be about 10%. (UK)

10097 PHOTOPRODUCTION OF NARROW RESONANCES. Knapp, B.; Lee, W.; Leung, P.; Smith, S.D.; Wijangco, A. (Columbia University, New York, New York 10027); Knauer, J.; Yount, D.; Nease, D.; Bronstein, J.; Coleman, R.; Cormell, L.; Gladding, G.; Gormley, M.; Messner, R.; O'Halloran, T.; Sarracino, J.; Wattenberg, A.; Wheeler, D.; Binkley, M.; Orr, R.; Peoples, J.; Read, L. Phys. Rev. Lett. 34: No. 16, 1040-1043 (21 Apr 1975).

A very narrow resonance with a mass of 3.105 GeV/c^2 is observed in the reaction $\gamma + Be \rightarrow \mu^+ + \mu^- + X$. The total cross section for this process, as well as its t distribution, is given. (auth)

10098 OBSERVATIONS OF NARROW ANTIPROTON-NEUTRON RESONANCES NEAR THRESHOLD. Kalogeropoulos, T.E.; Tzanakos, G.S. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. Lett. 34: No. 16, 1047-1050 (21 Apr 1975).

The behavior of the $\bar{p}n$ annihilation cross section has been observed above and below threshold by studying annihilations in deuterium at low energies with a ±2.5-MeV resolution. It varies inversely to the $\bar{p}n$ relative momentum except for a pronounced resonance with $(M,\Gamma) = (1897 \pm 1,25 \pm 6)$ associated with large proton momenta (200 to ~300 MeV/c) and a narrower one (consistent with resolution) at ~1932 MeV associated with lower (100–200 MeV/c) proton momenta.

Since the production of these $I=1$ states varies with the $\bar{p}n$ relative momentum, their spins are not zero. (auth)

10099 MEASUREMENT OF THE RELATION OF THE PHOTOPRODUCTION CROSS SECTIONS OF NEUTRAL PIONS ON NEUTRONS AND PROTONS AT 4. GeV AND 0.2 TO 1.2 (GeV/c)^2 MOMENTUM TRANSFER. Wessels, G. Bonn; Univ. Bonn (1973). 59p. (In German). INIS.

Thesis.

The measurement principle, the experimental arrangement and the interpreting of the experimental results are discussed. The cross section ratio indicates that the isoscalar part of the photoproduction amplitude has to be taken into account. (GE)

10100 INCLUSIVE ELECTROPRODUCTION OF FORWARD PROTONS FROM NEUTRON AND PROTON TARGETS. Bebek, C.J.; Brown, C.N.; Herzlinger, M.; Holmes, S.; Lichtenstein, C.A.; Pipkin, F.M.; Raither, S.; Sisterson, L.K. (Cyclotron Laboratory, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 34: No. 17, 1115-1118 (28 Apr 1975).

We report new measurements of the inclusive electroproduction of forward protons carried out at the Wilson Synchrotron Laboratory at Cornell University. Data were taken with deuterium at the (W, Q^2) points (2.15 GeV, 1.2 GeV^2), (2.15, 4.0), and (3.11, 1.2); data were taken with hydrogen at these points and the points (2.15, 2.0), (2.67, 3.3), and (3.11, 1.7). The invariant structure function is presented in terms of W, Q^2, and ω. (auth)

10101 COHERENT PHOTOPRODUCTION OF π^+ ON ^{3}He. Bachelier, D.; Bernas, M.; Boyard, J. L.; Jourdain, J. C.; Lazard, C.; Mario, Z.; Radvanyi, P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). pp 151-153 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A shift towards lower energies of the 3-3 resonance was observed in the coherent π^+ photoproduction on ^{3}He; no minimum appears around 11.6 fm^{-2} in the measured cross section versus q^2. Theoretical explanations are proposed for these two effects. (auth)

10102 $\pi^\pm$ He^4 ELASTIC SCATTERING AND ELECTROMAGNETIC PION RADIUS. Nichitiu, F. (Joint Inst. for Nuclear Research, Dubna (USSR)). pp 178-183 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Hofstadter and Sternheim originally proposed to obtain the electromagnetic pion radius from the analysis of elastic scattering $\pi^\pm$ on He^4. Up to now, some experiments and analyses have been made of the $\pi^\pm$He^4 elastic scattering which parametrized the nuclear amplitude in different ways (via the optical model like the Kisslinger model or simply with phase shifts) from which the pion radius still remains much larger than 2.0 fm. On the other hand, it was shown that the phase shift analysis for $\pi^\pm$ He^4 elastic scattering (energy range 24 ... 153 MeV) gives only two solutions and of these two, the first one seems to be the "physical solution". The ambiguity in nuclear amplitude, the total cross section and the incident beam energy are very important and have much larger effects on the electromagnetic pion radius calculations than all other Coulomb corrections. The average value of the electromagnetic pion radius calculated with solution I for the phase shifts and taking into account the nonpoint Coulomb phase shifts is $\langle r_\pi^2 \rangle^{1/2} = 0.80 \pm 0.40$ fm for the Crowe experiment (the error contains the uncertainty in the $X = \sigma_{el}/\sigma_{tot}$ ratio and therefore in the total cross section). (auth)

Weak

Refer also to abstract 10260.

10103 (CONF-740713-, pp II.166-II.170) CHARGED CURRENT NEUTRINO REACTIONS IN THE RESONANCE REGION. Derrick, M. (Argonne National Lab., IL). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A review is given of recent data on ν quasi elastic scattering $\nu n \to \mu^- p$, single pion production off proton and neutron targets $\nu p \to \mu^- p\pi^+$, $\nu n \to \mu^- p\pi^0$, $\mu^- n\pi^+$ and some double pion production reactions. Almost all the results came from exposures in the Argonne 12 ft bubble chamber operated with hydrogen and deuterium fills but comparisons are made with earlier data where appropriate. The axial form factors, axial vector masses, cross sections and excitation functions obtained for the reactions are discussed. (UK)

10104 (CONF-740713-, pp IV.61-IV.65) TEST OF SCALE INVARIANCE IN HIGH ENERGY MUON INTERACTIONS. Michigan State Univ.-Cornell Univ.-UC San Diego Collaboration. 1974.

. From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The concept of scale invariance has been tested at high energies in order to see whether the apparent point-like nature of the constituents is maintained with the shorter distances resolved at these energies. In the experiment reported here, 56.3 and 150 GeV muons are scattered from an iron target and momentum analyzed using a spectrometer consisting of magnetized iron toroids. The scaling test is made by comparing measured distributions in q^2 at these two incident muon energies, or by separate comparison with Monte Carlo predictions based on the SLAC results. Observed q^2 distributions are shown graphically. (UK)

10105 (CONF-740713-, pp IV.95-IV.100) "GARGAMELLE" EXPERIMENT. Aachen-Brussels-CERN-Ecole Polytechnique Paris-Milan-Orsay-University Coll.-London Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Further studies of charged-current neutrino interactions in the heavy liquid bubble chamber Gargamelle (freon CF_3Br filling) exposed to a focussed wideband beam at the CERN PS are presented. A linear increase with energy has been found for the neutrino total cross section for energies up to 20 GeV. In a study of strange particle production 200,000 pictures were analysed giving a lower limit for associated production normalized to the total charged current cross section of $\frac{\sigma_{ass.\,prod.}}{\sigma_{total}} > 0.5\%$ at $> 90\%$ CL and with an upper limit for $\Delta S = 1$ production of $\frac{\sigma S}{\sigma_{total}} < 2\%$ at $> 90\%$ CL. Structure functions and neutrino and antineutrino y-distributions for events in the scaling region $q^2 > 1$ GeV^2, $W > 4$ GeV^2 are shown graphically. Evaluations of two recent sum rules are shown. Experimental results of tests of the quark-parton model, ratio of π^+/π^-, are given. (UK)

10106 (CONF-740713-, pp IV.100-IV.104) HARVARD-PENNSYLVANIA-WISCONSIN-FERMILAB NEUTRINO EXPERIMENT. Imlay, R. (Univ. of Wisconsin, Madison). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Data have been obtained in an experimental study of neutrino interactions at the Fermi National Accelerator Laboratory. An enriched beam of neutrinos or antineutrinos impinged on a pure liquid scintillator ionization calorimeter in which the neutrino-nucleon interaction occurred, and in which the hadron energy E_h was measured. Considering the total cross section data, three aspects are discussed: (1) The value of α^ν, the slope of the total neutrino cross section vs energy obtained by a flux independent method which uses quasielastic events for normalization. (2) The relative energy dependence of the neutrino and anti-neutrino cross section. (3) The value of $\alpha^{\bar{\nu}}/\alpha^\nu$ obtained in a flux independent manner. Results of measurements of the distributions in the scaling variables $x = Q^2/2ME_h$ and $y = E_{h/E_\nu}$ are shown. (UK)

10107 (CONF-740713-, pp IV.105-IV.109) CALTECH-FERMILAB EXPERIMENT. Sciulli, F. (California Inst. of Tech., Pasadena). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

An experiment carried out in the FNAL dichromatic neutrino beam is reported. Neutrinos interacting in a 170 ton iron target through the process, $\nu_\mu + N \to \mu^- +$ hadrons, are selected when the muon traverses a trigger counter located downstream of the magnet. Results showing the distribution in the scaling variable $x = Q^2/2ME_h$, tests of scaling in the Q^2 distribution, and distributions in the inelasticity variable $y = E_{h/E\nu}$ are given. Also the total cross section was measured in a separate run using the FNAL narrow band beam. Ratio and sum of the neutrino and antineutrino cross sections are shown graphically. (UK)

10108 (CONF-740713-, pp IV.111-IV.113) RESULTS FROM THE CALTECH-FNAL EXPERIMENT. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Experimental searches for a lepton of the type Y^+ as required by some gauge theories and for neutral currents in high energy neutrino collisions are reported. It is concluded from preliminary observations that neutral current phenomena exist in interactions of both neutrinos and anti-neutrinos. (UK)

10109 (CONF-740713-, pp IV.114-IV.116) FURTHER INVESTIGATION ON THE EVENTS WITHOUT MUONS IN THE GARGAMELLE NEUTRINO EXPERIMENT. Aachen-Brussels-CERN-Ecole Polytechnique-Milan-Orsay-University Coll.-London Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Further positive evidence of neutrino-like events, without charged leptons in the final state, is presented from the Gargamelle experiment. The evidence is based on the distinction of quantities derived directly from the observed events inside the chamber without regarding the information from the external sources of background. Results for the ratio R of neutral current to charged current cross sections for ν and $\bar{\nu}$ are given. (UK)

10110 (CONF-740713-, pp IV.117-IV.120) RESULTS FROM THE HARVARD, PENNSYLVANIA, WISCONSIN-FNAL EXPERIMENT. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A survey is given of the data on muonless events/neutral currents accumulated in the Harvard, Pennsylvania, Wisconsin-FNAL experiment. Since preliminary results were published modifications to the apparatus have been carried out, these are indicated. Results for the ratio R of neutral current to charged current cross sections for inelastic ν and $\bar{\nu}$ interactions are given. (UK)

10111 (CONF-740713-, pp IV.121-IV.123) SEARCH FOR THE REACTION ANTI ν/sub μ/ + e^- → e^- + ANTI ν/sub μ/. Aachen-Brussels-CERN-Ecole Polytechnique-Milan-Orsay-University Coll.-London Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The amplitude of the weak neutral currents in neutrino interactions can be estimated via the study of neutrino scattering on electrons. A status report is presented of the search being made in Gargamelle for the reaction; $\bar{\nu}_\mu + \bar{e} \to \bar{e} + \bar{\nu}_\mu$, which, as the reaction $\nu_\mu + \bar{e} \to \bar{e} + \mu_\mu$, is forbidden at first order in the V-A theory. (UK)

10112 (CONF-740713-, pp IV.123-IV.126) RESULTS FROM THE ARGONNE 12-FOOT BUBBLE CHAMBER EXPERIMENT. Argonne-Concordia-Purdue Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The results from a neutral current search with the Argonne 12 ft bubble chamber are reported. Data from three exposures, one with a hydrogen filling and two with deuterium, a total of 700,000 pictures analysed, were used. The reactions (1) $\nu p \to \nu n \pi^+$, (2) $\gamma p \to \gamma p \pi^0$, (3) $\nu p \to \nu p$ and (4) $\nu n \to \nu p \pi^-$, are considered. The effects of selection criteria and background are disucssed. The neutral to charge current ratio is given for reactions (1), (2) and (4). No neutral currents were observed for reaction (3). (UK)

10113 (CONF-740713-, pp IV.127-IV.128) OBSERVATION OF MUONLESS NEUTRINO REACTIONS. Columbia-Illinois-Rockefeller-Brookhaven Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

An experiment in the neutrino beam at the AGS to look for muonless events induced by neutrinos is reported. Criteria used to define muonless events are stated-the total number of such events observed was 45. It was concluded that there was a clear neutral current signal. Having analyzed the single π^0 production channels in detail a value of the neutral to charged current ratio was calculated. (UK)

10114 (CONF-740713-, pp IV.128-IV.129) OBSERVATION OF SINGLE PION PRODUCTION IN NEUTRINO-LIKE INTERACTIONS WITHOUT A CHARGED LEPTON. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Following work on the 1967 bubble chamber experiment which included an upper limit for single π^+ production by a neutral current (Budagov et al. Phys. Lett.; 29B: 524 (1969) and Cundy et al. Phys. Lett.; 31B: 478 (1970)), the pictures were re-analyzed to find events consistent with the reactions: $\nu_\mu p \to \nu_\mu n \pi^+$ (1), $\nu_\mu p \to \nu_\mu p \pi^0$ (2), $\nu_\mu n \to \nu_\mu n \pi^0$ (3), $\nu_\mu n \to \nu_\mu p \pi^-$ (4), $\nu_\mu p \to \mu^- p \pi^+$ (5) where the final state protons and pions were positively identified. Results are given showing further evidence for the existence of weak neutral currents. (UK)

10115 MEASUREMENT OF THE PHASE OF THE CP-NONCONSERVATION PARAMETER η_{+-} AND THE K_S TOTAL DECAY RATE. Carithers, W.C.; Modis, T.; Nygren, D.R.; Pun, T.P.; Schwartz, E.L.; Sticker, H. (Columbia University, New York, New York 10027); Christenson, J.H. Phys. Rev. Lett. 34: No. 19, 1244-1246 (12 May 1975).

The interference of K_S and K_L in the decay $K_{S,L} \to \pi^+\pi^-$ has been studied by use of the K_S regeneration technique. With utilization of the results for the regeneration phase presented in the preceding Letter, the phase of η_{+-} has been determined as a function of the K_L-K_S mass difference: $\varphi_{+-} = (45.5° \pm 2.8°) + 120° (\Delta m - 0.5348)/\Delta m$. The data also provide an accurate measurement of the K_S total decay rate: $\Gamma_S = [(1.22 \pm 0.004) + 0.16(\Delta m - 0.5348)/\Delta m] \times 10^{10}$ sec^{-1}. (auth)

10116 MEASUREMENT OF THE REGENERATION PHASE IN CARBON FROM 4 TO 10 GeV/c. Carithers, W.C.; Modis, T.; Nygren, D.R.; Pun, T.P.; Schwartz, E.L.; Sticker, H. (Columbia University, New York, New York 10027); Christenson, J.H. Phys. Rev. Lett. 34: No. 19, 1240-1243 (12 May 1975).

A regeneration experiment exploring K_S-K_L interference in the decay modes $K_{S,L} \to \pi^+\pi^-$ and $K_{S,L} \to \pi^* l^* \nu$ ($l = \mu$ or e) has been performed at the Brookhaven National Laboratory alternating-gradient synchrotron. The regeneration phases in carbon obtained from the time-dependent charge asymmetry of the K_{e3} and $K_{\mu 3}$ modes are in good agreement and yield a combined result $\varphi_f \equiv \arg[f(0) - \bar{f}(0)] = -40.9° \pm 2.6°$ at the average K^0 momentum of 7.5 GeV/c. (auth)

10117 MEASURING OF THE $K^+ \to e^+\nu\gamma$ RELATIVE TO $K^+ \to e^+\nu$ BRANCHING RATIO. Mittag, E. Heidelberg; Univ. Heidelberg (1973). 67p. (In German). INIS.

Thesis.

The $K^+ \to e^+\nu\gamma$ decay is observed. There are 56 events registered between 236 and 247 MeV electron energy and $E(\gamma) \geq 100$ MeV. The measuring equipment is only sensitive at this range to the term proportional to the quadrat of vector plus axial vector amplitude, describing the emission of right-handed photons. The branching ratio of this γ-decay is found to be 1.08 (+0.25, −0.30). (GE)

10118 THE BETA-DECAY OF POLARIZED LAMBDA HYPERONS: ANGULAR DISTRIBUTIONS OF THE DECAY PRODUCTS IN THE LAMBDA REST SYSTEM. Stelzer, H. Heidelberg; Univ. Heidelberg (1972). 87p. (In German). INIS.

Thesis.

The beta decay of the Λ-hyperon was measured at the proton synchrotron at CERN, Geneva. The recording of the events took place in optical spark chambers. Besides the $\Lambda \to pe\nu$ decay, the nonleptonic decay $\Lambda \to p\pi^-$ was also registered in order to determine the branching ratio of the $\Lambda\beta$-decay and the polarization of the Λ-hyperons. In 768 of the total 1,078 observed $\Lambda\beta$-decays, it is possible to kinematically reconstruct the events in the center of mass system of the Λ-particles. From these events, one can determine the coefficient of the electron-neutrino angular correlation, the asymmetries of the three Λ-decay particles (p, e, ν) regarding the Λ-spin, of the vector product from the electron and neutrino direction. (GE)

10119 DETERMINATION OF THE $\Lambda \to$ PEANTI ν TRANSITION PROBABILITY. Mundhenke, R. Heidelberg; Univ. Heidelberg (1971). 93p. (In German). INIS.

Thesis.

In an experiment the transition ratios were measured by simultaneous investigation of $\Lambda \to p\pi^-$ and $\Lambda \to$ peanti ν decay in optical spark chambers. The leptonic Λ events could be identified by a gas-Cherenkov-counter for electrons and by time-of-flight measurements. From 1,078 observed $\Lambda \to$ peanti ν decays a branching ratio of $R = 8.55 \times 10^{-4}$ was obtained. Together with the form factor ratio g_1/f_1 determined in the same experiment follows $|f_1| = 0.318$. This value agrees with the CVC prediction. (auth)

10120 DECAY OF ψ (3684) INTO ψ (3095). Abrams, G.S.; Briggs, D.D.; Chinowsky, W.; Friedberg, C.E.; Goldhaber, G.; Kadyk, J.A.; Litke, A.M.; Lulu, B.A.; Pierre, F.M.; Sadoulet, B.; Trilling, G.H.; Whitaker, J.S.; Wiss, J.E.; Zipse, J.E. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720); Boyarski, A.M.; Breidenbach, M.; Bulos, F.; Feldman, G.J.; Fischer, G.E.; Fryberger, D.; Hanson, G.; Jean-Marie, B.; Larsen, R.R.;

Lüth, V.; Lynch, H.L.; Lyon, D.; Morehouse, C.C.; Paterson, J.M.; Perl, M.L.; Rapidis, P.; Richter, B.; Schwitters, R.F.; Tanenbaum, W.; Vannucci, F. Phys. Rev. Lett. 34: No. 18, 1181-1183 (5 May 1975).

We observe ψ (3684) to decay into ψ (3095) with a branching ratio of 0.57 ± 0.08. The branching ratio for the particular decay mode $\psi(3095) + \pi^+ + \pi^-$ is measured to be 0.32 ± 0.04. Remaining decays leading to ψ (3095) are largely, but not entirely, accounted for by the mode $\psi(3095) + \pi^0 + \pi^0$ if the two pions in this decay are in a state of zero isospin. (auth)

10121 EVIDENCE FOR $\Delta S = -\Delta Q$ CURRENTS OR CHARMED-BARYON PRODUCTION BY NEUTRINOS. Cazzoli, E.G.; Cnops, A.M.; Connolly, P.L.; Louttit, R.I.; Murtagh, M.J.; Palmer, R.B.; Samios, N.P.; Tso, T.T.; Williams, H.H. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. Lett. 34: No. 17, 1125-1128 (28 Apr 1975).

We report on the production by neutrinos of an event with negative strangeness. In an exposure of the Brookhaven National Laboratory 7-ft cryogenic bubble chamber to a broad-band neutrino beam 335 events were observed, one of which fits the reaction $\nu p \to \mu^- \Lambda^0 \pi^+ \pi^+ \pi^+ \pi^-$. Alternative explanations are examined and none found with a probability greater than 3×10^{-3}. The event thus represents a large violation of the $\Delta S = \Delta Q$ rule or alternatively the production and decay of a charmed baryon state. The most plausible mass for this state is found to be 2426 ± 12 MeV. (auth)

10122 SEARCH FOR A PARITY-VIOLATING CONTRIBUTION TO NUCLEON-NUCLEON SCATTERING. Nagle, D. E.; Hwang, C. F.; Jarmie, N.; Lovoi, P. A.; McKibben, J. L.; Mischke, R. E.; Ohlsen, G. G.; Potter, J. M.; Stevens, R. R. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)); Debrunner, P. pp 70-72 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

One manifestation of the weak interaction between nucleons would be a parity-violating effect in nucleon-nucleon scattering. It is expected that such effects exist, at least at the level of 10^{-7} of the normal cross section, in low energy pp and pd scattering. An experiment was undertaken at 15 MeV to detect a small dependence of the pp scattering cross section on the longitudinal polarization of the beam. Current efforts are concentrating on reducing systematic effects which at present restrict the sensitivity of the level of 2×10^{-4}. (auth)

10123 SOLID STATE PHYSICS. Crowe, K. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 445-450 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A review of μ^+ precession experiments is presented. The behavior of the spin of the muon as it interacts in different solids and liquids is discussed, as is muonium formation, "fast" depolarization, and slower relaxation in solids and solutions with various chemical and magnetic ions. The interpretation of muonium hyperfine spectra in germanium and silicon, as well as the recently observed anomalous μ^+ precession in silicon, are presented. The use of muons to probe internal magnetic fields in ferromagnets is also reported. (auth)

Strong (Baryon-induced)

Refer also to abstract 10311.

10124 (CERN-74-8, pp 1-40) NUCLEON-NUCLEON SCATTERING. Present State and Future Prospects. Edgington, J. A. 10 Apr 1974.

From topical meeting on intermediate energy physics; Zuoz, Switzerland (4 Apr 1973).

In topical meeting on intermediate energy physics, Lyceum Alpinum, Zuoz, Engadin, Switzerland, 4-13 April 1973. Proceedings. (Schweizerisches Inst. fuer Nuklearforschung, Villigen; European Organization for Nuclear Research, Geneva (Switzerland)).

A brief introduction summarizes the improved facilities for for nucleon-nucleon scattering experiments provided by the SIN, TRIUMF and LAMPF accelerators. Various aspects of the field are then reviewed in relation to experiments suggested to be carried out in the relevant energy range, 200 to 800 MeV. Topics covered include nucleon-nucleon elastic scattering (energy dependence, charge independence, charge symmetry, dynamics), strong-interaction symmetries (parity, time-reversal), bremsstrahlung, np capture, pion production, and deuteron investigations. (Switzerland)

10125 (CERN-74-18) SYMPOSIUM ON ANTINUCLEON-NUCLEON INTERACTIONS, LIBLICE-PRAGUE, 25-28 JUNE 1974. Proceedings. Montanet, L. (European Organization for Nuclear Research, Geneva (Switzerland)). 20 Sep 1974. 528p. INIS.

From symposium on antinucleon-nucleon interactions; Liblice-Prague, Czechoslovakia (25 Jun 1974).

These proceedings contain the papers and reviews presented at the syposium, as well as extracts from the discussions. They attempt to give a complete view of knowledge on antinucleon-nucleon interactions. The following subjects are discussed: formation of heavy mesons, using $\bar{p}p$ and $\bar{p}n$ channels; properties of nonannihilation channels, in particular of the $\Delta\bar{\Delta}$, $\bar{p}p2\pi$, and $pp4\pi$, and of their diffractive character; elastic scattering and charge exchange; hyperon production; two-body annihilations, in particular 2π, $\pi\eta$, $K\bar{K}$; pionic annihilations and annihilations with production of strange particles; charge and neutral pion multiplicities; clustering effects; correlations, inclusive single-particle distributions. Relevant theoretical and phenomenological ideas are also presented. New ideas on the treatment of correlations, multiplicities, and of the multiparticle processes, particularly abundant in antinucleon-nucleon annihilations, are given. (auth)

10126 (CONF-740713-, pp I.3-I.10) SOME ASPECTS OF DIFFRACTION AS SEEN IN BUBBLE CHAMBER EXPERIMENTS. Derrick, M. (Argonne National Lab., IL). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Bubble chamber data showing the low mass diffractive peak in high energy hadron collisions are reviewed with particular emphasis on the specific final states that contribute. To demonstrate the universality of the effect results showing the missing mass from protons in a 69 GeV Mirabelle experiment and the 4 prongs in a 100 GeV π^+p and pp experiment in the 30 in. Fermi Lab. chamber are presented together with a summary of the pp data from the high energy bubble chamber exposures at FNAL. Work on the cross section for the effect, the momentum transfer dependence, and the individual contributions to the peak, are summarized. The comparison of the inclusive diffractive processes $\pi^-p \to p + \text{any}$ and $pp \to p + \text{any}$, the first representing pion diffraction and the second proton diffraction, at 205 GeV/c carried out in the 30 in. chamber at FNAL are considered. (UK)

10127 (CONF-740713-, pp I.11-I.13) MEASUREMENT OF $pp \to (p\pi^+\pi^-) + X$ AT THE CERN ISR: SCALING TESTS AND EVIDENCE FOR DOUBLE EXCITATION. Aachen-UCLA-CERN Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

In a magnetic spectrometer experiment at CERN ISR to study small angle production of multiparticle systems at very high energies, evidence has been found at $s = 53$ and 35 for a pronounced enhancement near $x = p/p_{max} \sim +1$ in the total momentum of $(p\pi^+\pi^-)$ systems. This observation implies the presence in pp interactions at very high energies of a quasi-two-body component, presumably diffractive excitation, in the inclusive process: $pp \to (p\pi^+\pi^-) + \text{anything}$. The overall features of the data are described. It is shown that (1) Both the cross section and the internal structure of the enhancement in the reaction with $x > 0.9$ are energy independent between $\sqrt{s} = 35$ and 53 GeV. (2) The main component of "anything" is found to be a proton but in at least 15% of the time there is clear evidence for a double excitation component in the reaction when this is not a proton and a rapidity gap occurs. (UK)

10128 (CONF-740713-, pp I.13-I.15) EXPERIMENTAL RESULTS ON INELASTIC DIFFRACTION SCATTERING IN PROTON-PROTON COLLISIONS AT THE ISR. CERN-Hamburg-Orsay-Vienna Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Experimental data on the reaction $pp \to p(n\pi^+)$ have been obtained using the Split Field Magnet (SFM) detector, complemented with special neutron counters at the CERN ISR. Preliminary analysis of data obtained from 7200 events at $\sqrt{s} = 53$ GeV is reported. The differential cross section $(d\sigma/dt)$ for the reaction integrated over $(n\pi^+)$ invariant mass is presented graphically showing two distinct slopes. The s-dependence of these exponential slopes is shown and compared to the slope observed in elastic scattering. It is noted that all slopes are increasing with s, at approximately the same rate as in elastic scattering. Shrinkage is a phenomenom shared by elastic and inelastic diffraction scattering. There appear to be two distinct components of inelastic diffraction scattering, N^* production and non-resonant pion production. The distribution in polar angle in a Jackson reference frame for all masses is presented which shows forward-backward asymmetry which increases with increasing mass. At

mass values above 2.4 GeV diffraction dissociation into the one pion channel is completely dominated by the non-resonant component. (UK)

10129 (CONF-740713-, pp I.16-I.19) COHERENT DISSOCIATION OF HADRONS ON NUCLEI. Rosen, J. L. (Northwestern Univ., Evanston, IL). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A summary is made of the results of a series of experiments using nuclei as targets for coherently dissociating incident hadrons. By coherent it is meant that the recoiling nucleus remains in its ground state so that the contributions to the reaction amplitude from the individual nucleons are added coherently. The acceptable exchange mechanisms include coulomb, pomeron, ω and f^0 exchanges. A variety of exclusive channels have been studied. Diffractive dissociation and copious Coulomb dissociation are reported. (UK)

10130 (CONF-740713-, pp I.19-I.20) LARGE ANGLE NEUTRON-PROTON ELASTIC SCATTERING FROM 6 TO 12 GeV/c. Longo, M. J.; Chanowski, J. P.; Gray, S. W.; Gustafson, H. R.; Jones, L. W.; Stone, J. L. (Univ. of Michigan, Ann Arbor). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Results are presented of a neutron-proton elastic scattering experiment. Neutrons, which scattered in a 30 -cm long hydrogen target, were detected in a thick-plate spark chamber array. Recoil protons were detected in a conventional magnetic spectrometer with wire chambers. Based on data for $|t| < 6$ (GeV/c)^2 the n-p differential cross sections agree quite well with available p-p data throughout this momentum range. At 7 GeV/c the cross sections fall off very smoothly with increasing $|t|$. As the beam momentum increases a kink gradually develops near $|t| = 1.2$ (GeV/c)^2 and becomes quite pronounced by 12.0 GeV/c. (UK)

10131 (CONF-740713-, pp I.20-I.21) NEUTRON-PROTON AND NEUTRON-NUCLEUS TOTAL CROSS SECTIONS FROM 40 TO 300 GeV. Longo, M. J. (Univ. of Michigan, Ann Arbor); Ayre, C. A.; Gustafson, H. R.; Jones, L. W.; Murthy, P. V. R.; Cork, B. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The measurements were carried out in a neutron beam at Fermi Laboratory. The standard transmission technique was employed with a 1.2 -m long hydrogen target. A total absorption calorimeter was used to determine the neutron energy with a precision of about ±6%. The n-p total cross sections obtained agree rather well with previous n-p and p-p data, but are significantly higher than the p-p total cross sections presented by Kycia et al (Proc. of the XVII Int. Conf. on High Energy Phys. London. (1974) I 32-35). The results indicate a gradual rise of about 1.4 mb in the n-p total cross section between 50 and 300 GeV/c. The n-d total cross sections obtained are shown graphically. The discrepancy between the p-p total cross sections at 200 and 300 GeV/c measured by Gustafson et al (Phys. Rev. Lett.; 32: 441 (1974)) and those already cited of Kycia et al are considered with reference to the methods and techniques of measurement. (UK)

10132 (CONF-740713-, pp I.21-I.23) SIMULTANEOUS MEASUREMENT OF SPINS IN pp ELASTIC SCATTERING. Yokasawa, A. (Argonne National Lab., IL). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Experiments on p-p elastic scattering at 6 GeV/c using polarized beams and polarized targets, are discussed. It is stated that nine independent measurements are needed in order to determine p-p amplitude and seven for πp amplitude. Preliminary data are presented of C_{NN} (N, N; O, O) (beam, target; scattered, recoil) measurements at 6 GeV/c. The ratio of the differential elastic pp sections for each spin state to the spin averaged cross section ($d\sigma/dt$) is shown plotted against $p_\perp^2$ (GeV/c)^2. It is seen that C_{NN} has a maximum at around $p_\perp^2 = 0.7$ (GeV/c)^2, where the polarization parameter has a minimum and about where the cross section breaks. (UK)

10133 (CONF-740713-, pp I.23-I.25) K^-p AND ANTI pp ELASTIC SCATTERING AND TWO-BODY ANNIHILATION AT 6.2 GeV/c. CERN-Ecole Polytechnique-Stockholm-Orsay-Genova-INFN Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

In an experiment using spark chambers and proportional chambers at the CERN Synchrotron, the differential cross sections for the elastic channels K^-p, and $\bar{p}$p and the annihilation channels of $\bar{p}$p into $\pi^-\pi^+$ and K^-K^+ at 6.2 GeV/c have been measured. Most of the c.m. angular range was covered. It was found that the dip at about $t = -0.5$ (GeV/c)^2 seems to move towards larger t-values as energy increases. The dip remains equally pronounced at 6.2 GeV/c. The most surprising feature of the data is the apparent constancy of the cross section for $\cos\theta_{cm}$ between -0.5 and 0.0 from 5.0 GeV/c to 6.2 GeV/c, whereas the cross section in the backward direction ($u = 0$) decreases with energy as s^{-10}. In the annihilation channel $\bar{p}p \to \pi^-\pi^+$ a dip in the forward direction was noticed. The annihilation cross sections $\pi^-\pi^+$ and K^-K^+, show a decrease in the forward direction consistent with baryon exchange, while the wide-angle cross sections are decreasing like s^{-10}. In the backward direction the $\pi^-\pi^+$ channel shows a decrease consistent with baryon exchange. No events were observed for the channel K^-K^+. (UK)

10134 (CONF-740713-, pp I.27-I.28) POLARIZATION MEASUREMENTS IN PP ELASTIC SCATTERING AT 45 GeV/c. CEN-Saclay-IHEP-Serpukhov-JINR-Dubna-ITEP-Moscow Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Preliminary results are presented on the polarization in pp elastic scattering at 45 GeV/c, showing that P takes negative values in the region of the well known dip structure at $0.6 \leq |t| \leq 0.9$ (GeV/c)^2. The results presented correspond to 10^6 elastic pp events and are shown graphically together with the results of $\bar{p}$p and K^-p elastic scattering polarization at 40 GeV/c. The polarization in K^-p and in $\bar{p}$p is compatible with zero at small four-momentum transfer. For $|t| > .25$ (GeV/c)^2 the $\bar{p}$p results exhibit a structure which can be compared to that obtained by eikonal models with broken exchange degeneracy. The pp results for $0.1 < |t| < 0.3$ (GeV/c)^2 show a slight decrease in the value of the polarization as compared to lower energy data. (UK)

10135 (CONF-740713-, pp I.29-I.30) ELASTIC SCATTERING AT FNAL. Meyer, D. (Univ. of Michigan, Ann Arbor). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Brief remarks on the π^-p, K^-p, pp, and $\bar{p}$p elastic scattering data from FNAL are given. (LBS)

10136 (CONF-740713-, pp I.30-I.31) EXPERIMENTAL RESULTS ON LARGE-ANGLE ELASTIC pp SCATTERING AT THE CERN ISR. CERN-Hamburg-Orsay-Vienna Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

New data in elastic pp scattering have been obtained using the Split Field Magnet (SFM) Detector at the CERN ISR. A preliminary analysis of data in the momentum transfer range 0.8 GeV$^2 < -t < 3.0$ GeV^2 at the two extreme ISR energies, $\sqrt{s} = 23$ GeV and $\sqrt{s} = 62$ GeV is reported. The dominant property of the cross section data is the narrow minimum near $t = -1.4$ GeV^2. It is shown that the t value of the cross section minimum decreases with energy: (1.45 ± 0.02) GeV^2 at $\sqrt{s} = 23$ GeV and (1.30 ± 0.05) GeV^2 at $\sqrt{s} = 62$ GeV and the cross section of the second maximum increases with energy. Both observations, the inward moving dip and the upward moving maximum, can be understood as the interference effect of a shrinking small t amplitude with a large t amplitude which is energy independent in strength and slope. (UK)

10137 (CONF-740713-, pp I.32-I.35) TOTAL CROSS SECTION OF $\pi^\pm$, $K^\pm$, p AND ANTI p ON PROTONS AND DEUTERONS BETWEEN 50 AND 200 GeV/c. Brookhaven-Fermilab-Rockefeller Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Measurements of the total cross sections of $\pi^\pm$, $K^\pm$, p and $\bar{p}$ on protons and deuterons in 50 GeV/c steps between 50 and 200 GeV/c are reported. The experimental technique employed is

described. The results of the measurements are shown graphically. As the incident momentum increases from 50 to 200 GeV/c the pp total cross section rises by 2%. The $\bar{p}p$ cross sections continue to fall with increasing momentum, but the rate decreases markedly, and above 150 GeV/c there is very little variation. Cross sections of p and $\bar{p}$ on deuterons show a momentum dependence similar to those on protons. The $\bar{p}d$ cross section is also nearly constant above 150 GeV/c. The cross sections for π^+ and K^+ all show a rise with increasing momentum. (UK)

10138 (CONF-740713-, pp I.41-I.70) HIGH ENERGY, LOW MULTIPLICITY REACTIONS. Diddens, A. N. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A review is given of high energy, low multiplicity reactions covering; total cross sections and ρ = Re f(0)/Im f(0), elastic scattering, charge exchange and related reactions, polarization, and diffractive reactions of low multiplicity diffraction dissociation. A number of recent total cross section measurements are cited and the results for π^+p, K^+p and p^+p are shown graphically. The energy dependence of the total and differential π^-p charge-exchange cross sections are discussed. New polarization measurements in pp, $\bar{p}p$ and K^-p scattering are discussed. The energy dependence of exclusive reactions is considered. A new method which has been developed to measure diffraction dissociation process using pd → Xd, in which the detection of the recoil deuteron should isolate a clear diffraction dissociation of the proton, is discussed. It is concluded that some qualitative information has been gained on the asymptotic behavior of reaction mechanisms. (LBS)

10139 (CONF-740713-, pp I.71-I.75) HIGH ENERGY INELASTIC DIFFRACTION. Loebinger, F. K. (Univ. of Manchester, Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Data from experiments carried out by various groups (CHLM, USA-USSR, Michigan-Rochester and ANL-NAL) investigating the diffractive nature of the highs × part of the inelastic pp and pd cross sections are compared. All groups find that the t-dependence of the cross section varies a great deal with M^2. The data of the USA-USSR and Michigan-Rochester groups are compared graphically with the results of the CHLM experiment at similar s values. Common features are discussed. Comparison is made of the data which specifically tests to what extent and over what range the inelastic diffractive cross section scales. Many groups have reported that the diffractive peak is mainly confined to relatively low multiplicities. Resonance structure of the low M^2 inelastic peak observed by the USA-USSR group is shown graphically. (LBS)

10140 (CONF-740713-, pp I.90-I.92) COSMIC RAYS AND PARTICLE INTERACTIONS WITH NUCLEI. Yodh, G. B. (Univ. of Maryland, College Park). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Evidence from cosmic ray experiments on the behavior of $\sigma_{p\text{-air}}$ (inelastic) from 10^4 to 10^8 GeV is presented. Data from various experiments on the spectra of unaccompanied hadrons from 10^3 to 2×10^4 GeV and attenuation of primary cosmic ray protons are considered. Three curves for energy variation of $\sigma_{p\text{-air}}$ based upon three different energy dependence of pp interactions beyond ISR range (for σ_{TOT} and b) calculated using standard Glauber methods are shown in the same figure. The need for measurements at energies above 10^6 GeV to discriminate between several different models is evident. The value of $\sigma_{p\text{-air}}$ obtained from the study of Zenith angle distribution of showers with a fixed number of muons and electrons is discussed. It is concluded that present data on $\sigma_{p\text{-air}}$ from unaccompanied hadron spectra can be consistent with rising σ_{pp} or constant σ_{pp} at ~48 mb above 10 TeV, however, EAS measurements suggest a continued ln s or $\ln^2 s$ rise of σ_{pp}. (UK)

10141 (CONF-740713-, pp I.176-I.180) POLARIZED PROTON BEAM PHYSICS AND RELATED TOPICS. Wicklund, A. B. (Argonne National Lab., IL). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A review is given of recent results from the polarized proton beam facility at the Argonne Zero Gradient Synchrotron (ZGS) operating at 6 GeV/c. Features of the beam which are important in designing experiments are given. Results quoted include: forward np elastic cross sections, five independent cross sections (the five pp elastic amplitudes are: helicity non flip (N_0), single flip (N_1), double flip natural parity (N_2) A_1 and unnatural parity exchange (π)) at $t = -.5$ GeV^2 with spins along the normal, spin correlation C_{nn} over a wide range of t, the five spin correlations in inclusive $p\uparrow p \to \Lambda\uparrow X$, production of N^* and Δ^{2+} in reactions $p\uparrow p \to p\pi^+n$ and $p\uparrow p \to p\pi^+\pi^-p$, polarized target measurements on backward $\pi^-p \to p\pi^-$ at 2.9 and 3.5 GeV/c, and polarization in $\pi^-p \to \Sigma^-K^+$ at 3.5 GeV/c. (UK)

10142 (CONF-740713-, pp II.13-II.16) PARTIAL WAVE ANALYSIS OF ($K\pi\pi$) AND ($K\omega$): SYSTEMS. Otter, G. (Technische Hochschule, Aachen). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The partial wave analyses for the three pion systems $K^-p \to (K^-\pi^+\pi^+)p$ and $K^-p \to (\bar{K}^0\pi^-\pi^+)n$ undertaken by various groups are reported and compared. Although the first reaction is diffractive produced and the second is a charge-exchange reaction, both show similar partial wave analysis results. The results of two groups who have investigated the reaction $K^-p \to (\bar{K}\omega)p$ at 16, 10 and 7.3 GeV/c are considered. It is concluded that the low mass ($K\omega$) system seems to be diffractively produced and shows similar partial wave analysis properties to those of the diffractive ($K\pi\pi$) system. (UK)

10143 (CONF-740713-, pp II.27-II.49) PLENARY REPORT ON MESON SPECTROSCOPY. Wagner, F. (Lawrence Berkeley Lab., CA). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The progress made in recent years in meson spectroscopy is considered with reference to papers presented to the XVII International Conference on High Energy Physics(London) 1974. Data obtained for $\pi\pi$ below 1 GeV, for $\pi\pi$ above 1 GeV where the system becomes inelastic and therefore ambiguities must occur, and for low energy $K\pi$ systems are reviewed. The field of formation experiments which is discussed is characterized by many new data but no reliable analysis has been performed. An explanation is offered for the reconciliation of the strong S-interaction, observed in both $\pi\pi$ and $K\pi$ systems, with the quark model. (94 references) (UK)

10144 (CONF-740713-, pp V.3-V.8) INCLUSIVE PION PRODUCTION AT HIGH p_T. Jariskog, G. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

New results of inclusive pion production at high p_T presented to the XVII International Conference on High Energy Physics, London (1974) are listed in tabular form, from which a good picture is obtainable although the precision in absolute normalization still needs to be improved. The following observations on the data are made: (1) The parametrization suggested by parton models $E\,(d^3\sigma/dp^3) = p_T^{-N} f(X_T)$, with $f(X_T) = e^{-aX_T}$, gives a fair description of pion data at large p_T(or X_T), however with different values of the parameters N and a depending on the region in p_T and s over which the fits are done, typically giving $N \sim 8$ at the ISR for $X_T \lesssim .5$ and $N \sim 11$ at the larger values of X_T at FNAL. (2) As at low p_T, there is an extended central plateau in rapidity at large p_T. (3) The absolute yields of charged and neutral pions (as deduced from photon spectra) are very similar with a possible small surplus of π_0. (4) The increase of $(d\sigma/dy)$ with s is 24 ± 9% over the ISR energies. (UK)

10145 (CONF-740713-, pp V.8-V.12) PRODUCTION AT LARGE TRANSVERSE MOMENTUM OF PARTICLES HEAVIER THAN PIONS. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

New data presented to the XVII International Conference on High Energy Physics, London (1974) on inclusive heavy particle production are considered. The British-Scandinavian group submitted proton-proton data covering the kinematic region $23 \le \sqrt{s} \le 63$ GeV and $0.5 \le P_\perp \le 4.8$ GeV, and the Chicago-Princeton group proton-nucleus collision data in the region $19.4 \le \sqrt{s} \le$

27.4 and $0.5 \leq p_\perp \leq 7.6$ GeV. The gross features of the data are: (1) The invariant cross sections for inclusive $K^\pm$, p, and $\bar{p}$ production look much like those for π production. (2) Heavy particles are produced copiously at large $p_\perp$. (3) The invariant cross sections for heavy particle production are s dependent at large $p_\perp$, although not at small $p_\perp$. (4) The antiparticle-particle ratios for heavy particles is quite sensitive to kinematic variables. (UK)

10146 (CONF-740713-, pp V.13-V.20) CORRELATIONS IN HIGH TRANSVERSE MOMENTUM FINAL STATES. Di Lella, L. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A study of particle correlations in high energy collisions leading to high transverse momentum secondaries undertaken to test the hypothesis that hadron production at high values of the transverse momentum $p_\perp$ result from large angle scattering of elementary constituents within the proton is reported. An enhancement of the charged particle multiplicity, in opposite direction with respect to that of a high $p_\perp$ hadron, was noted which can largely be explained in terms of kinematic effects. The effects have made any search for jets of hadrons opposite to a high $p_\perp$ hadron inconclusive. Positive momentum correlations were observed between two high $p_\perp$ hadrons in the same azimuthal region and are certainly of dynamical origin. (UK)

10147 (CONF-740713-, pp V.41-V.43) OBSERVATION OF LEPTONS OF LARGE TRANSVERSE MOMENTUM. I. CERN-Columbia-Rockefeller-Saclay Experiment. Segler, S. L. (Rockefeller Univ., New York). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A search for electrons of large transverse momentum emitted from proton-proton collisions has been performed at the CERN ISR at a centre of mass energy $\sqrt{s} = 52.7$ GeV. Electrons are momentum analyzed by a magnetic spectrometer and identified by a Cerenkov counter located inside the spectrometer. A lead glass array placed behind the spectrometer provides further electron identification and energy measurement. The apparatus is located at 90° with respect to the centre line of the incoming beam directions, the centre of mass motion being towards the detector. The results are discussed and the inclusive cross section for electrons of either charge divided by two and plotted as a function of E is shown. (UK)

10148 (CONF-740713-, pp V.43-V.46) OBSERVATION OF LEPTONS OF LARGE TRANSVERSE MOMENTUM. II. Columbia-FNAL Experiment. Yamanouchi, T. (National Accelerator Center, Batavia, IL). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Results of the observation of directly produced high transverse momentum electrons and muons in proton-beryllium collisions at 300 GeV, are given. The experimental apparatus is described. The charge asymmetries of the directly produced electrons are given. Positive and negative electrons have identical yields and are averaged to give the invariant cross sections. Preliminary results of the cross sections for muons are shown and no difference between positive and negative particles is seen. Within the present systematic uncertainties these cross sections are consistent with those of the electrons. (UK)

10149 (CONF-740713-, pp V.47-V.49) OBSERVATION OF LEPTONS OF LARGE TRANSVERSE MOMENTUM. III. Princeton-Chicago Experiment. Piroue, P. A. (Princeton Univ., NJ). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Results of an experiment performed at the Fermi National Accelerator Laboratory to observe muons produced directly in Cu and W targets by 300 GeV incident protons, are given. A yield of muons was found which is approximately a constant fraction (0.8×10^{-4}) of the pion yield for both positive and negative charge and for transverse momenta ($P_\perp$) between 1.5 and 5.4 GeV/c. (UK)

10150 (CONF-740713-, pp V.50-V.51) OBSERVATION OF LEPTONS OF LARGE TRANSVERSE MOMENTUM. IV. Wisconsin-Harvard-Penn-Chicago Experiment. Imlay, R. (Univ. of Wisconsin, Madison). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The results of the observation of prompt production of muons in nucleon-nucleon collisions in an experiment at the internal target laboratory of Fermi National Accelerator Laboratory are given. The experimental arrangement is described and illustrated. Relative μ^+ and μ^- yields arising from π and K decay as a function of bombarding energy, and also the observed muon momentum spectrum, are both shown graphically. (UK)

10151 (CONF-740713-, pp V.52) OBSERVATION OF LEPTONS OF LARGE TRANSVERSE MOMENTUM. V. British Universities Experiment. Cence, R. (Univ. of Hawaii, Honolulu). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

(In proceedings of the XVII international conference on high energy physics.

Results of an experiment performed to search for muons with high transverse momenta as evidence for the existence of a massive object, (for example the Intermediate Vector boson) which has a muon decay, are given. The experiment was designed to be sensitive to muons of a minimum transverse momentum of 4 GeV/c and after subtraction of background particles no signal was observed with a transverse momentum greater than this limit. The upper limit from this experiment and model predictions using modified parton distributions exclude W masses from 10 to 18 GeV/c^2. (UK)

10152 (CONF-740713-, pp V.53-V.54) OBSERVATION OF LEPTONS OF LARGE TRANSVERSE MOMENTUM. VI. Serpukhov Experiment. Nurushev, S. (Inst. of High Energy Physics, Serpukhov, USSR). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Results of measurements of the energy spectrum and longitudinal polarization of muons with large transverse momentum (1.8 GeV/c $\leq P_\perp \leq$ 2.8 GeV/c) produced in the proton beam interaction with an internal copper target at the IHEP 70 GeV accelerator are presented. Separation of muons produced directly in the target or connected with short-lived particle decays ("direct muon") was performed by changing the distance between the target and the copper absorber. Thus, in the experiment there was a possibility to measure the muon intensity from the hypothetical intermediate boson decay $W \rightarrow \mu e$, from muon pair production or from some similar process. The experimental data obtained contradict the fact of existence of intermediate boson in the mass interval from 6.5 to 8.5 GeV/c^2. The invariant cross sections of "direct muon" production and π^+-meson production are compared graphically. Results of the measurement of the polarization of muons with energy 14 GeV ($P_\perp$ = 1.8 GeV/c) are given. (UK)

10153 CONF-740713-, pp V.55) OBSERVATION OF LEPTONS OF LARGE TRANSVERSE MOMENTUM. VII. Chairman's Summary. Lederman, L. M. (Columbia Univ., New York). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The statement $(e/\pi)^+ \cong (e/\pi)^- \cong (\mu/\pi)^+ \cong (\mu/\pi)^- \cong 10^{-4}$ is considered. From results presented to the XVII International Conference on High Energy Physics (1974) it is concluded that the statement is independent of: P_T from 1.5 to 5 GeV/c, nucleon target size, CM viewing angle and s from $\sqrt{s} = 7$ to $\sqrt{s} = 53$, all to within a factor of 2 or so. The implications are that leptons and pions have a common origin. (UK)

10154 (CONF-740713-, pp V.57-V.81) PLENARY REPORT ON LARGE TRANSVERSE MOMENTUM REACTIONS. Landshoff, P. V. (Cambridge Univ., Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Reviewing the subject of large transverse momentum reactions three related subjects are discussed: (1) Elastic scattering and other exclusive processes at large momentum transfer (data, theory). Production of hadrons with large transverse momentum in inclusive reactions (single-particle distributions, constituent models, jet structure, particle ratios, inclusive-exclusive connection, other models). Production of leptons in hadron-hadron collisions. (UK)

10155 (CEA-CONF-2731) MEASUREMENT OF SPIN CORRELATION IN PROTON-PROTON SCATTERING AND COMPARISON WITH THE LOCAL THEORIES OF HIDDEN VARIABLES. Lamehi-Rachti, M.; Mittig, W. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1974. 19p. (In French). INIS.

From colloquium, a half century of quantum mechanics; Strasbourg, France (2 May 1974).

Spin correlation was measured in a proton-proton scattering experiment in order to test the validity of hidden variable theories. The experiment differed from that of Fox in concerning particles of non-zero mass at rest, thus localizable by a Lorentz transformation, while the preparation of the state and the measurement of polarization brought into play the nuclear forces. A resolving polyethylene (CH_2)n target and a carbon polarimeter were used. At the energy of the experiment (between 13 and 14 MeV in the laboratory) almost all the diffusion is a singlet diffusion. (FR)

10156 (LA-UR-75-836) PARITY NONCONSERVATION IN P-P AND P-NUCLEUS SCATTERING. Bowman, J. D. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 14p. (CONF-750222-2). Dep. NTIS $4.00.

From symposium on interaction studies in nuclei; Mainz, F.R. Germany (17 Feb 1975).

The longitudinal asymmetry in the total cross section sigma/sub +/-sigma/sub -//sigma/sub +/-sigma/sub -/ for p vector-p scattering at 15 MeV was measured to be $(1 \pm 4) \times 10^{-7}$. The asymmetry for p vector-Be at 6 GeV was measured to be $(5 \pm 9) \times 10^{-6}$. The experimental methods are discussed with emphasis on the control of systematic errors. (auth)

10157 DISTRIBUTION OF MULTIPLICITY IN INELASTIC COHERENT COLLISIONS OF PROTONS WITH NUCLEI IN THE ENERGY INTERVAL 20-200 GeV. Azimov, S.A.; Gulamov, K.G.; Gulyamov, U.G.; Chernov, G.M. (Physico-technical Institute, Uzbek Academy of Sciences). JETP Lett. 21: No. 2, 76-77 (20 Jan 1975).

We present and discuss the multiplicity distributions of charged particles in diffraction-coherent proton-nuclear interactions in a wide energy interval. A comparison is made with the data on the diffraction dissociation in *pp* collisions. (auth)

10158 PRODUCTION OF A NEW HADRON IN 300-GeV PROTON INTERACTIONS. Jain, P.L.; Girard, B. (High Energy Experimental Laboratory, Department of Physics, State University of New York at Buffalo, Buffalo, New York 14214). Phys. Rev. Lett. 34: No. 19, 1238-1240 (12 May 1975).

We report the production of a new neutral hadron with a lifetime $\sim 10^{-13}$ sec in a 300-GeV proton interaction in nuclear emulsion. (auth)

10159 EXPERIMENTE DER KERNPHYSIK UND IHRE DEUTUNG. T. 1. (Experiments of Nuclear Physics and Their Interpretation. P. 1). Bodenstedt, E. (Bonn Univ. (F. R. Germany)). Mannheim, F. R. Germany; Bibliographisches Inst. (1972). 290p.

There were 37 fundamental experiments in the field of nuclear and particles physics are described. The scale of experiments reaches from determination of the elemental charge and discovery of radioactivity via fundamental properties of nuclei, neutrons, muons, and pions up to proton-proton scattering. The experimental set-up and performance are described in detail. Moreover, all experiments are interpreted theoretically and models are developed. (auth)

10160 DIMUON PRODUCTION BY NEUTRONS. Knapp, B.; Lee, W.; Leung, P.; Smith, S.D.; Wijangco, A. (Columbia University, New York, New York 10027); Knauer, J.; Yount, D.; Nease, D.; Bronstein, J.; Coleman, R.; Cormell, L.; Gladding, G.; Gormley, M.; Messner, R.; O'Halloran, T.; Sarracino, J.; Wattenberg, A.; Wheeler, D.; Binkley, M.; Orr, R.; Peoples, J.; Read, L. Phys. Rev. Lett. 34: No. 16, 1044-1047 (21 Apr 1975).

A very narrow resonance with a mass of 3.1 GeV/c^2 is observed in the reaction $n + \mathrm{Be} \rightarrow \mu^+ + \mu^- + X$. The total cross section for this process, as well as its $P_\perp^2$ and x distribution, is given. (auth)

10161 SINGLE-PION PRODUCTION IN $\bar{p}p$ INTERACTIONS NEAR THRESHOLD. Burns, R.R.; Condon, P.E.; Donahue, J.; Mandelkern, M.A.; Michelotti, L.; Price, L.R.; Schultz, J. (Department of Physics, University of California, Irvine, California 92664). Phys. Rev. D 11: No. 5, 1004-1009 (1 Mar 1975).

Results are reported on the reaction $\bar{p}p \rightarrow \bar{N}N\pi$ at center-of-mass energies of 2.063, 2.094, and 2.114 GeV. The cross sections for π^0 production at these energies are 22 ± 7, 35 ± 9, and 126 ± 26 μb; those for the π^- and π^+ production are 20 ± 7, 41 ± 10, and 79 ± 20 μb and 16 ± 6, 43 ± 10, and 47 ± 16 μb, respectively. The cross section obeys the energy dependence of phase space and joins smoothly onto data at higher energies. The cross section as a function of energy is relatively well fitted by a calculation based on current-algebra predictions of soft-pion emission. Resonance production is small, but there is a possible $I = 1$ enhancement which may be the S (1930). Our highest energy $\bar{p}p \rightarrow \bar{p}p\pi^0$ channel may proceed approximately 50% through Δ (1236) $\bar{p} + \bar{\Delta}$ (1236) p. Predicted nonstrange exotic mesons coupled preferentially to $\bar{N}N$ and $\bar{N}N\pi$ are not seen. (auth)

10162 MEASUREMENT OF RADIATIVE PION-PROTON SCATTERING AT BACKWARD PHOTON ANGLES. Sober, D.I.; Arman, M.; Blasberg, D.J.; Haddock, R.P.; Leung, K.C.; Nefkens, B.M.K.; Schrock, B.L.; Sperinde, J.M. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 11: No. 5, 1017-1035 (1 Mar 1975).

We have measured the differential cross sections for $\pi^+ p$ and $\pi^- p$ radiative scattering ($\pi^+ p \rightarrow \pi^+ p\gamma$) at an incident kinetic energy of 298 MeV with photons produced at very large angles to the incident and scattered particles. The measured photon spectrum extended to 120 MeV. For photon energies below 30 MeV, the results are in agreement with the conventional soft-photon formalism. In the hard-photon region the data fail to reflect the Δ (1236) resonance in the final state, and are in substantial disagreement with existing theoretical models. (auth)

10163 *pp* INTERACTIONS AT 300 GeV/*c*: γ AND NEUTRAL-STRANGE-PARTICLE PRODUCTION. Sheng, A.; Davidson, V.; Firestone, A.; Nagy, F.; Peck, C. (California Institute of Technology, Pasadena, California 91109); Dao, F.T.; Hanft, R.; Lach, J.; Malamud, E.; Nezrick, F.; Dzierba, A.; Poster, R. Phys. Rev. D 11: No. 7, 1733-1742 (1 Apr 1975).

In a 35 000-picture exposure of the Fermilab 30-in. hydrogen bubble chamber to a 300-GeV/*c* proton beam 1863 neutral V^0's were measured. The inclusive cross sections for γ, K_S^0, Λ^0/Σ^0, and $\bar{\Lambda}^0/\bar{\Sigma}^0$ are 257 ± 18 mb, 7.3 ± 0.6 mb, 3.6 ± 0.4 mb, and 1.0 ± 0.3 mb, respectively. The correlation with charged particles and other inclusive features are studied. (auth)

10164 INCLUSIVE γ, π^0, K^0, AND Λ PRODUCTION IN 12.4-GeV/*c pp* INTERACTIONS. Jaeger, K.; Campbell, J.; Charlton, G.; Swanson, D. (Argonne National Laboratory, Argonne, Illinois 60439); Fu, C.; Rubin, H.A.; Glasser, R.G.; Koetke, D.; Whitmore, J. Phys. Rev. D 11: No. 7, 1756-1776 (1 Apr 1975).

In an exposure of the Argonne National Laboratory 12-foot hydrogen bubble chamber to a beam of 12.4-GeV/*c* protons, we have measured the total and differential cross sections for the inclusive reactions $p + p \rightarrow \gamma + X$, $\pi^0 + X$, $K^0 + X$, and $\Lambda + X$, as well as estimates for the inclusive η and Σ^0 cross sections. We present the average number of π^0, K^0, and Λ as a function of the associated charge multiplicity. We observe that the average charge multiplicity in *pp* collisions is the same whether or not a π^0, K^0, or Λ is also produced in the interaction. Invariant cross sections are presented as a function of $P_\perp^2$ and x, the Feynman scaling variable. The π^0 differential cross sections are consistent with the relation $d\sigma/dP(\pi^0) = \frac{1}{2}[d\sigma/dP(\pi^+) + d\sigma/dP(\pi^-)]/2$ for all pion momenta P. The differential cross section for Λ production indicates a break in the distribution of $|t - t_{min}| = 1.4$ (GeV/c)^2. The polarization of the Λ's is found to be consistent with zero for all values of x. (auth)

10165 CROSS SECTIONS FOR "DIFFRACTIVE" p+p→p+X FROM 100 TO 400 GeV. Schamberger, R.D. Jr.; Lee-Franzini, J.; McCarthy, R. (State University of New York at Stony Brook, Stony Brook, New York 11794); Childress, S.; Franzini, P. Phys. Rev. Lett. 34: No. 17, 1121-1124 (28 Apr 1975).

We have measured the cross section for $p+p \rightarrow p+X$ for M_X^2 up to constant fraction of s. We observe no rise for $130 < E < 400$ GeV. The inelastic cross section for $0 < M^2 < 0.06s$ is 2.50 ± 0.05 mb for various values of s from 263 to 752 GeV^2. (auth)

10166 HIGH-ENERGY HEAVY IONS: A NEW AREA FOR PHYSICS RESEARCH. Heckman, H. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 403-415 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Emerging from the first heavy ion experiments at the Bevatron are preliminary results that reveal high energy heavy ion research to be a promising and stimulating new area of physics research, pertinent to elementary particles, nuclear structure, and cosmic rays. Amongst the heavy ion physics experiments in progress at the Bevatron are studies on the fragmentation of projectile and target nuclei, coherent pion production and the production and detection of high energy hypernuclei. The experiments on the fragmentation of beam nuclei at 1.05 and 2.1 GeV/nucleon have shown specific relevance to contemporary theory on inclusive reactions, particularly to the concept of factorization, i.e., the modes of fragmentation of beam nuclei are independent of the target nucleus. Complementary experiments on the fragmentation of target nuclei are concerned with the characteristic differences between the production of light and heavy fragments from heavy element targets under bombardment by p, ^{12}C, and ^{16}O beams at 2.1 GeV/nucleon. The investigation on the feasibility of producing high energy hyperfragments, via the two-body re-

action $^{A}Z + p \rightarrow {}^{A+1}Z_{\Lambda} + K^{+}$, where the target proton and heavy ion projectile become, respectively, a K^{+} and a high velocity hyperfragment, may lead to a new technique in the field of hypernuclear physics. (auth)

10167 MOMENTUM DISTRIBUTIONS OF NEUTRONS IN ^{2}H, ^{3}He AND ^{4}He FROM QUASI-ELASTIC SCATTERING OF 1.3 GeV/c PROTONS. Kirkby, P.; Daniels, J. M.; Gajdicar, T.; Friedlander, S.; Krebs, G. F.; Coombes, H.; Dennig, E. I.; Kairies, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 383-386 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Measurements are reported of quasi-elastic scattering of 1.3 GeV/c protons off neutrons in the three light nuclei ^{2}H, ^{3}He and ^{4}He. Momentum distributions of neutrons in these nuclei are determined along 3 mutually perpendicular axes and gaussian distributions fitted to each of the three components. Comparison is made to other work on momentum distributions of protons in these nuclei. (auth)

10168 MEASUREMENT OF DEUTERON-PROTON BACKWARD ELASTIC SCATTERING AT INCIDENT DEUTERON MOMENTA 3.43, 4.50, 5.75 AND 6.60 GeV/c. Dubal, L.; Hargrove, C. K.; McKee, R. J.; Mes, H. (National Research Council of Canada, Ottawa, Ontario); Bird, L.; Halliwell, C.; Hincks, E. P.; Morrison, R. W.; Walters, J. (Carleton Univ., Ottawa, Ontario (Canada)); Thompson, A. C. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). pp 209-212 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Differential cross sections for dp elastic scattering in the range 60 to 175° cm were measured at 3.43, 4.50, 5.75, and 6.60 GeV/c incident deuteron momentum. Data are compared with predictions of the one pion exchange model and the baryon pick-up model. A reasonable fit to the momentum variation and differential cross sections are found for the one pion exchange model. When the data are plotted against the variable Δ of the baryon pick-up model, the s-independence is greatly reduced. (auth)

10169 MOMENTUM COMPONENTS OF THE DEUTERON: 200-400 MeV/c. Igo, G. J.; Nasser, M. (California Univ., Los Angeles (USA)). pp 200-204 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Large angle, elastic proton-deuteron scattering is analyzed with the Kerman-Kisslinger pick-up model including second order (distorted wave) corrections. (auth)

10170 COMPLETE DIFFERENTIAL CROSS SECTIONS FOR THE REACTION $pp \rightarrow d\pi^{+}$ FROM 3.0 TO 5.0 GeV/c. Anderson, H. L.; Larson, D.; Myrianthopoulos, L. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.); Dubal, L.; Hargrove, C. K.; Hincks, E. P.; McKee, R. J.; Mes, H. (National Research Council of Canada, Ottawa, Ontario); Kessler, D.; Thompson, A. C. (Carleton Univ., Ottawa, Ontario (Canada)). pp 205-208 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Complete differential cross section measurements for the reaction $pp \rightarrow d\pi^{+}$ were carried out at eight values of incident proton momentum from 3.0 to 5.0 GeV/c. These measurements exhibit a strong dependence on momentum transfer and energy and show that the previously observed enhancement in the forward cross section due to the $\Delta(1950)$ damps out quickly as the production angle departs from zero degrees, in contrast to the well known enhancement at 1.35 GeV/c, which is evident at all angles. (auth)

10171 PROTON DIFFRACTION DISSOCIATION AND ELASTIC SCATTERING FROM ^{4}He. Ekeloef, T.; Herz, A. J. (European Organization for Nuclear Research, Geneva (Switzerland)); Hagberg, E.; Kullander, S. (Uppsala Univ. (Sweden). Gustaf Werner Institutet); Bruton, P. C.; Curran, C. S.; Davies, J. K.; Fisher, S. M.; Heymann, F. F.; Imrie, D. C. pp 136-139 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Preliminary results are presented of an experiment to study the coherent interaction of high energy protons with ^{4}He. The elastic angular distribution is in good agreement with Glauber model calculations at four-momentum transfers below 0.2 $(GeV/c)^{2}$. At larger values of the four-momentum transfer there is evidence for the expected single-double scattering interference minimum and for a secondary maximum due to double scattering, but the data are too preliminary to permit detailed comparisons with current models at the present time. The effective-mass distribution of the $p\pi\pi$ system for a restricted class of $p \rightarrow p\pi\pi$ events, in which the momenta of all three fast secondaries are measured, has the expected peaks at 1.5 and 1.7 GeV/c^{2}. There is also an indication of structure at a mass close to 2.0 GeV/c^{2}. (auth)

10172 p-^{4}He COHERENT SCATTERING AT 24 GeV/c. Observation of Elastic Scattering and Production Processes By a Missing Mass Method. Berthot, J.; Gardes, J.; Meritet, A.; Pauty, J. F.; Peynet, G.; Querrou, M.; Vazeille, F. (Clermont-Ferrand Univ., 63 (France). Lab. de Physique Corpusculaire); Burq, J. P.; Chemarin, J.; Ille, B. pp 140-142 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The coherent scattering of protons on helium 4 is observed at 24 GeV/c using a missing mass method, i.e. detecting the recoil nucleus and measuring with a high accuracy its identification parameters, angle and energy. The angular spectrum of ^{4}He for each energy channel in single and double scattering t region exhibits some peaks due to baryon resonances (N^{*}_{ζ}) at rest mass of 1500 and 1700 MeV. (auth)

10173 STUDY OF NUCLEAR INTERACTIONS OF 200 GeV PROTONS IN EMULSION. Otterlund, I. (Lund Univ. (Sweden)); Hebert, J.; Hebert, C. J. D.; Areti, H. (Ottawa Univ., Ontario (Canada)); Patel, P. M.; Hartner, G. (McGill Univ., Montreal, Quebec (Canada)); Vincent, M. A. (Quebec Univ., Montreal (Canada)); Baumann, G.; Devienne, R. (Nancy-1 Univ., 54 (France)); Lory, J. pp 427-431 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The results of an international collaboration on proton-nucleus interactions using nuclear emulsions exposed to a 200-GeV proton beam at the National Accelerator Laboratory, Batavia, are presented. A large number of interactions were analyzed including events with heavily-ionizing tracks and therefore distributions are given with all final nuclear states included in the data. The shower particle multiplicity was found to be $\langle n_{s} \rangle = 12.9 \pm 0.2$ and the average number of heavy prongs $\langle N_{h} \rangle = 7.4 \pm 0.2$. These results are impossible to interpret with any simple intranuclear cascade model. The shape of the angular distribution of particles produced and its variation with the number of heavy prongs N was analyzed. (auth)

10174 $d\sigma(0^{0})/d\Omega$, $\sigma_{tot\ el}$ AND $ReA(0^{0})$ FOR ELASTIC pp-SCATTERING IN THE 1-1000 MeV ENERGY RANGE. Amirkhanov, I. V.; Zul'karneev, R. Ya.; Murtazaev, H.; Nadejdin, V. S.; Satarov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). pp 47-50 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The cross sections of elastic pp-scattering in the region of Coulomb-nuclear interference at 100, 500, 600, 630, and 670 MeV were measured. On the basis of these experimental results and those obtained by other scientists the values of $Re\ A(0^{0})$ and of $\sigma_{tot\ el}$ were determined in the energy region from 1 to 1000 MeV. The energy dependence of $Re\ A(0^{0})$ was discussed from the point of view of dispersion relations. (auth)

10175 EVIDENCE FOR DOUBLE DIFFRACTIVE EXCITATION IN $pp \rightarrow (p\pi^{+}\pi^{-}) + X$ AT THE CERN ISR AND TEST OF FACTORIZATION. Baksay, L.; Boehm, A; Foeth, H.; Staude, A. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.); Lockman, W.; Medinnis, M.; Meyer, T.; Rander, J.; Schlein, P.; Webb, R. (California Univ., Los Angeles (USA)). Phys. Lett., B; 55: No. 5, 491-494(17 Mar 1975).

In a magnetic spectrometer experiment at the CERN Intersecting Storage Rings (ISR), evidence is obtained for the existence of double diffractive excitation in the reaction $pp \rightarrow (p\pi^{+}\pi^{-}) + X$ at $\langle t_{1}' \rangle = 0.03\ GeV^{2}$ and $\sqrt{s} = 53$ GeV. X is observed to be a multibody low mass system 12% of the time, in agreement with the same rate observed in $pp \rightarrow p + X$. (auth)

10176 COHERENT PARTICLE PRODUCTION AND THE PROPAGATION OF HADRONIC SYSTEMS THROUGH NUCLEAR MATTER. Van Hove, L. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 109-113 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Recent experiments on coherent diffraction dissociation of high energy hadrons on nuclei lead to study the progagation of excited hadronic systems through nuclear matter. The theoretical treatment of this problem must take into account the evolution of the internal state of the hadronic system as it collides with successive nucleons. The main elements of such a treatment are introduced. The time-dependent approach to the multiple scattering theory of Glauber is generalized. (auth)

Strong (Meson-induced)

Refer also to abstracts 10328–10329.

10177 (CERN-HERA–75-1) COMPILATION OF K^+N CROSS SECTIONS BELOW 2 GeV/c. Casadei, U.; Giacomelli, G.; Lugaresi-Serra, P.; Mandrioli, G.; Rossi, A. M.; Viaggi, F. (European Organization for Nuclear Research, Geneva (Switzerland)). 5 Mar 1975. 45p. Dep. NTIS (US Sales Only) $5.25.

A collection of K^+N total, elastic, charge exchange, and inelastic cross sections below 2 GeV/c is presented. (auth)

10178 (CONF-740713-, pp I.25-I.27) ELASTIC SCATTERING AND POLARIZATION MEASUREMENTS AT SERPUKHOV. Nurushev, S. (Inst. of High Energy Physics, Serpukhov, USSR). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A survey of work carried out at Serpukhov covering elastic scattering of π^- mesons on protons in the coulomb-nucleon interference region for incident momenta ranging from 33 GeV/c to 60 GeV/c and elastic scattering of positive particles from protons at 43 GeV/c is given. From the measurements of the π^-p differential elastic cross section it was found that the value of p gradually falls from -0.109 ± 0.012 at $p = 33.52$ GeV/c to -0.011 ± 0.018 at $p = 59.40$ GeV/c. Preliminary results of experiments on π^+p, K^+p and pp elastic differential cross sections in the momentum-transfer squared range $.08 \leq |t| < .8(\mathrm{GeV/c})^2$ in which the angles and the momenta of both the recoil proton and the forward-going particles were measured, are discussed. The polarization parameter P has been measured for π^-p, K^-p and $\bar{p}p$ elastic scattering at 40 GeV/c for $0.1 \leq |t| \leq 1.0$ $(\mathrm{GeV/c})^2$. The results of the analysis of all the events for the polarization in K^-p and $\bar{p}p$ elastic scattering are reported. (UK)

10179 (CONF-740713-, pp I.35-I.37) REACTIONS $\pi^-p \to$ ETAN AND $\pi^-p \to X^0n$ AT 15 AND 40 GeV/c. CERN-Serpukhov Collaboration. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Data on π^-p charge exchange interactions giving a recoil neutron and a forward-produced state which decays in a final state containing only γ rays ($\pi^0 \to 2\gamma$, $\eta \to 2\gamma$, $\omega \to \pi^0\gamma$, $X^0 \to 2\gamma$, $\pi^0\pi^0$, etc) are being collected at the Serpukhov accelerator at incident π^- momenta between 15 and about 40 GeV/c by a IHEP-CERN (Karlsruhe-Pisa-Vienna) group. A description is given of the experimental layout. Results of total cross sections for X^0 production with decay to $\gamma\gamma$ are shown graphically. (UK)

10180 (CONF-740713-, pp I.37-I.40) REACTION $\pi^-p \to \pi^0n$ AND $\pi^-p \to$ ETAN BETWEEN 20 AND 100 GeV/c. Barnes, A. V. (California Inst. of Tech., Pasadena); Mellema, D. J.; Tollestrup, A. V.; Walker, R. L.; Dahl, P. L.; Johnson, R. A.; Kenney, R. W.; Pripstein, M. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

An experiment is in progress at FNAL to measure various neutral final state reactions of π^- on protons. Preliminary results for the reactions: (1) $\pi^-p \to \pi^0n$ and (2) $\pi^-p \to \eta n_{\gamma\gamma}$ in the momentum internal 20 GeV/c to 100 GeV/c are reported. Background difficulties are discussed. The experimental arrangement and the photon detector are shown schematically and are fully discussed. Distributions of $d\sigma/dt$ for the reactions at 20.7, 40.6, 66 and 101 GeV/c were obtained. The small t region for reaction (1) from 20.7 to 101 GeV/c is shown. (UK)

10181 (CONF-740713-, pp II.16-II.20) COHERENT DISSOCIATION OF MESONS INTO 3, 4, AND 5 PARTICLES. Edelstein, R. M. (Carnegie-Mellon Univ., Pittsburgh). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The six papers on coherent dissociation of mesons into 3, 4 and 5 particles presented to the XVII International Conference on High Energy Physics (London) 1974 are considered and the results compared. The conclusion reported is that the filtered diffracted signal seen is much like the earlier data from hydrogen scattering (Ascoli et al. Phys. Rev.; D7: 669 (1973)) and Antipov et al. Nucl. Phys.; B63: 153 (1973)). Results reported by Kruse et al. (Coherent pion dissociation into three pions on heavy nuclei. Paper 671) are discussed in detail and the yields for different 3π mass regions at 23 GeV/c, and the contributions of the important spin parity states in $\pi^- \to (3\pi)^-$ on carbon (coherent and incoherent) are shown. It is concluded that the observations of A_2 production in nuclear targets are consistent with a picture in which Pomeranchuk exchange dominates A_2 production at high energies. It is suggested that an important modification of the present concept of elastic and inelastic diffractive scattering to include a possible tensor exchange structure as well as the conventional non-flip amplitude is required. (UK)

10182 (JINR–P1-8767) ANALYSIS OF THE MULTIPLE CHARGED PARTICLE PRODUCTION IN π^-n INTERACTIONS AT 5 GeV/c. Gvasheli, A. Sh.; Lomakin, Yu. F.; Salukvadze, R. G.; Hubua, D. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The analysis of the multiple charged particle production in π^-n interactions at 5 GeV/c was performed. The average multiplicity of charged particles was obtained to be $\langle n_s \rangle = 2.67 \pm 0.22$. The KNO -scaling was observed. (auth)

10183 (LPNHEX-T-74-02) STUDY OF $\pi^0\pi^0$ FINAL STATES IN $K^-p \to \Lambda^0$ + NEUTRALS REACTIONS, FOR A K^- MOMENTUM COMPRISED BETWEEN 0.52 AND 0.9 GeV/c. Wuthrick, J. P. (Ecole Polytechnique, 75- Paris (France). Lab. de Physique des Hautes Energies; Paris-6 Univ., 75 (France)). 1974. 186p. (In French). INIS.

In most experiments studying the formation of baryonic resonances, some difficulties occur due to the mixing of isospins 0 and 1; for that reason it was interesting to study the neutral final states in reactions like $K^-p \to \Lambda^0$ + neutrals, since all have a definite isospin. In order to do that, 1,200,000 photographs were taken at CERN in the 1,20 Heavy Liquid Bubble chamber filled with a propane-freon mixture (giving 10% interactions on free protons), with an incident momentum of the K^- such that all C. M. energies between 1580 and 1750 MeV were accessible. The thesis studies principally the reactions $K^-p \to \Lambda^0\pi^0\pi^0$ and $K^-p \to K^-p \to \Sigma^0\pi^0\pi^0$. The main problems in this experiment are the separation between the events produced on nuclei and on hydrogen, and the mixing of all channels due to the loss of true gammas and the addition of spurious ones. Cross sections are presented in five energy bins leading to a peak in the 1690 MeV region for the $\Lambda^0\pi^0\pi^0$ channel. All the results are fairly consistent with those computed from the charged channels, using isospin invariance. An analysis of the Dalitz Plot gives the proportion of quasi-two-body events in the sample ($75 \pm 13\%$) $\Sigma(1385)\pi^0$ in the $\Lambda^0\pi^0\pi^0$'s and $60 \pm 25\%$ $\Lambda(1405)\pi^0$ in the $\Sigma^0\pi^0\pi^0$'s). A further analysis gave no evidence for the formation of the $\Lambda(1690)$. (FR)

10184 (RL-75-059) MEASUREMENT OF K^-p ELASTIC DIFFERENTIAL CROSS SECTIONS BETWEEN 610 AND 943 MeV/c. Adams, C. J.; Davies, J. D.; Dowell, J. D. (Science Research Council, Chilton (UK). Rutherford Lab.). 1974. 20p. (RPP/H-139). Dep. NTIS (US Sales Only) $4.00.

Measurements of K^-p elastic scattering were carried out at 14 momenta between 610 and 943 MeV/c over the angular range $-0.9 < \cos\theta < 0.9$. The results agree well with the best existing data and have significantly smaller errors. (auth)

10185 STUDY OF THE PRODUCTION OF THE (1236) ISOBAR IN THE REACTION $\pi^- + d \to p + \Delta^-(\Delta^-$ backward) FROM 1.03 TO 1.68 GeV/c. Abramov, B.M.; Dukhovskoi, I.A.; Kishkurno, V.V.; Krutenkova, A.P.; Kulikov, V.V.; Radkevich, I.A.; Fedoreta, V.S. (Institute of Theoretical and Experimental Physics). JETP Lett. 21: No. 3, 90-91 (5 Feb 1975).

We measured the differential cross section of the backward production of the Δ (1236) isobar in the reaction $\pi^- + d \to p + \Delta^-$ at four values of the momentum of the incident negative pions in the interval from 1.03 to 1.68 GeV/c. The measured cross sections are in satisfactory agreement with the calculations performed on the basis of the triangular reaction mechanism. (auth)

10186 SINGLE-PARTICLE DISTRIBUTIONS IN INCLUSIVE π^-p REACTIONS AT 10.0 AND 15.5 GeV/c. Delay, M.J.; Heller, K.; Miller, G.; Romer, H.; Rothberg, J.E.; Schenck, A.; Williams, R.W. (University of Washington, Seattle, Washington 98195). Phys. Rev. D 11: No. 5, 975-986 (1 Mar 1975).

Single-particle distributions have been measured at the Stanford Linear Accelerator Center for the inclusive processes $\pi^+p \to \pi^+X$ and $\pi^+p \to \pi^-X$ at 10.0 and 15.5 GeV/c. The kinematic range for

secondary pions was $p_T = 0.15$ GeV/c to 0.9 GeV/c and $x = 0$ to 0.5. The differential cross sections have been assumed to be slowly varying and have been fitted to smooth functions of x and p_T. Cross sections have been obtained for all incoming and outgoing pion charges. The cross sections for the reactions with incident and outgoing pions of like charge are higher than those for unlike charge, but have similar shape. The cross section as a function of the rapidity is plotted together with that of pp inclusive scattering at CERN ISR energies, for the purpose of comparing pion and proton fragmentation. (auth)

10187 SINGLE-γ DECAYS OF η' (958), ω (783), ϕ (1019), AND Ξ^{*-}(1535). Kalbfleisch, G.R.; Strand, R.C. (Brookhaven National Laboratory, Upton, New York 11973); Chapman, J.W. Phys. Rev. D 11: No. 5, 987-995 (1 Mar 1975).

We present direct evidence on single-γ decays in which the γ rays were converted to electron showers in tantalum plates or leaded-glass windows installed in the BNL 31-inch bubble chamber or in its 2 at.% neon-hydrogen filling. A > 90% pure sample of 135 $\eta' \to \pi^+\pi^-\gamma$ events is obtained. The Dalitz-plot projections show the ρ meson and the sine-squared angular dependence clearly. The asymmetry between π^+ and π^- mesons in the decay is found to be 0 ± 0.1. In addition, upper limits to the following decay modes are found: $(\eta' \to \omega\gamma) \leq 0.05$, $(\omega \to \pi^+\pi^-\gamma) \leq 0.06$, $(\phi \to \pi^+\pi^-\gamma) \leq 0.06$, and $(\Xi^{*-}(1535) \to \Xi\gamma^-) \leq 0.04$, all at the 90% confidence level. (auth)

10188 REACTION $\pi^+ d \to \pi^+\pi^+\pi^- d$ AT 15 GeV/c. Horne, C.P.; Hagopian, S.; Hagopian, V.; Lannutti, J.E.; Pewitt, N.D.; Wilkins, D.P.; Wind, B. (Department of Physics, The Florida State University, Tallahassee, Florida 32306); Bensinger, J.R. Phys. Rev. D 11: No. 5, 996-1003 (1 Mar 1975).

About 1800 events of the reaction $\pi^+ d \to \pi^+\pi^+\pi^- d$ have been obtained from 387 000 photographs of the SLAC 82-in. bubble chamber corresponding to a 495 ± 25 μb cross section. The increasing cross section of this reaction with beam momentum is explained in terms of minimum momentum-transfer cutoff. The D^* (2200) is observed as both $d\pi^+$ and $d\pi^-$ mass peaks. The $A_1(\rho^0\pi^+)$ is consistent with a Deck-type mechanism. The $A_3(f^0\pi^+)$ is also observed, but the A_4 peak recently claimed is not seen in these data. There is no statistically significant 3π mass enhancement at the A_2 region, but indirect evidence indicates some A_2 production. (auth)

10189 POLARIZATION STUDY OF INCLUSIVE Λ PRODUCTION IN K^-p INTERACTIONS. Chung, S.U.; Eisner, R.L.; Protopopescu, S.D. (Brookhaven National Laboratory, Upton, New York 11973); Field, R.D. Phys. Rev. D 11: No. 5, 1010-1016 (1 Mar 1975).

Data are presented on the inclusive reaction $K^-p \to \Lambda X$ at 7.3 GeV/c and compared with recent results at 3.93 and 14.3 GeV/c. The s dependence of the polarization can be qualitatively understood in the framework of triple-Regge phenomenology. (auth)

10190 DIFFERENTIAL CROSS SECTIONS FOR K^+p ELASTIC SCATTERING FROM 0.865 TO 2.125 GeV/c. Abe, K.; Barnett, B.A.; Goldman, J.H.; Laasanen, A.T.; Steinberg, P.H. (University of Maryland, College Park, Maryland 20742); Marmer, G.J.; Moffett, D.R.; Parker, E.F. Phys. Rev. D 11: No. 7, 1719-1732 (1 Apr 1975).

We report on an experiment to obtain differential cross sections for K^+p elastic scattering in the vicinity of the possible exotic baryon, the Z_1^* (1900). The differential cross sections are based on typically 70 000 selected events in the angular region $-0.9 \leq \cos\theta_{c.m.} \leq 0.9$ at each of 22 momenta from 0.865 to 2.125 GeV/c. The data are intended for use in partial-wave analysis to search for the Z_1^*. (auth)

10191 π^+p BACKWARD ELASTIC SCATTERING FROM 2 TO 6 GeV/c. Lennox, A.J.; Poirier, J.A.; Rey, C.A.; Sander, O.R. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556); Baker, W.F.; Eartly, D.P.; Pretzl, K.P.; Pruss, S.M.; Wehmann, A.A.; Koehler, P. Phys. Rev. D 11: No. 7, 1777-1795 (1 Apr 1975).

The backward angular distributions obtained in an experiment at the Zero Gradient Synchrotron of Argonne National Laboratory were used to systematically study the energy dependence of the 180° differential cross section for π^+p elastic scattering in the center-of-mass energy region from 2159 to 3487 MeV. At each of thirty-eight incident pion momenta between 2.0 and 6.0 GeV/c, a focusing spectrometer and scintillation counter hodoscopes were used to obtain differential cross sections for typically five pion scattering angles from 141° to 173° in the laboratory. Values for $d\sigma/d\Omega$ at 180° were then obtained by extrapolation. A resonance model and an interference model were used to perform fits to the energy dependence of $d\sigma/d\Omega$ (180°). Both models led to good fits to our data and yielded values for the masses, widths, parities, and the product of spin and elasticity for the Δ (2200), Δ (2420), Δ (2850), and Δ (3230) resonances. Our data confirm the existence of the Δ (3230) and require the negative-parity Δ (2200). (auth)

10192 SEARCH FOR CHARMED-PARTICLE PRODUCTION IN 15-BeV/c π^+p INTERACTIONS. Baltay, C.; Cautis, C.V.; Cohen, D.; Csorna, S.; Kalelkar, M.; Pisello, D.; Schmidt, E. (Columbia University, New York, New York 10027); Smith, W.D.; Yeh, N. Phys. Rev. Lett. 34: No. 17, 1118-1121 (28 Apr 1975).

A search for the production of charmed particles in 15-BeV/c π^+p interactions has been carried out. The search was sensitive to charmed particles in the 1.5 to 4.0 BeV mass range, with lifetimes $\lesssim 10^{-11}$ sec, decaying into a strange particle with up to eight additional pions. No evidence for the production of such particles was found. (auth)

10193 THE EXPERIMENTAL SITUATION IN COHERENT PRODUCTION. Bingham, H. H. (California Univ., Berkeley (USA). Dept. of Physics). pp 96-108 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Some recent experimental results on coherent production reactions from nuclear targets are reviewed and discussed: the A_3 and L controversy, A_1 branching ratio and 0^- absorption, $Q \to K\omega$, $\pi \to 5\pi$, doubly diffractive processes, $K \to K^*(890)$, $\pi \to \rho(?)$, $\pi \to 4\pi(?)$, $\Delta I \neq 0$ processes. (auth)

10194 THE CONVERSION PROBABILITY AND EMISSION RATIO OF CHARGED Σ-HYPERONS FOLLOWING K^- MESON CAPTURE AT REST IN CARBON. Vander Velde-Wilquet, C.; Keyes, G. S.; Sacton, J.; Wickens, J. H. (Institut Interuniversitaire des Sciences Nucleaires, Brussels (Belgium)); Davis, D. H.; Tovee, D. N. (University Coll., London (UK). Dept. of Physics). Nucl. Phys., A; 241: No. 3, 511-523(14 Apr 1975).

A study was made of K^- meson interactions at rest in the CERN 1.1 m^3 heavy liquid bubble chamber filled with a mixture of hydrocarbons. The data are used to determine the internal conversion probability, $C(\Sigma^-)$, of Σ^- hyperons produced in association with π^+ mesons by K^- meson interactions in carbon nuclei, the relative emission frequencies of $(\Sigma^+\pi^-)$ and $(\Sigma^-\pi^+)$ pairs, $E(\Sigma^+\pi^-/\Sigma^-\pi^+)$, and the emission frequency $E(\Sigma^\pm\pi^\pm/K^-)$, of $(\Sigma^\pm\pi^\pm)$ pairs per K^- meson absorption in carbon, the branching fraction, $P(\Sigma^-\pi^+/K^-)$, for the primary process $K^- + p \to \Sigma^- + \pi^+$ in carbon and the trapping probability, $T(\Lambda^0)$, for Λ^0 hyperons produced by Σ^- hyperon interactions in carbon nuclei. The results are: $C(\Sigma^-) = 0.38 \pm 0.03$, $E(\Sigma^+\pi^-/\Sigma^-\pi^+) = 1.25 \pm 0.09$, $E(\Sigma^\pm\pi^\pm/K^-) = 0.164 \pm 0.006$, $P(\Sigma^-\pi^+/K^-) = 0.127 \pm 0.004$ and $\Gamma(\Lambda^0) = 0.13 \pm 0.04$, where the errors quoted are statistical and correspond to one standard deviation. Possible systematic errors were estimated to be at most of the same order of magnitude as the statistical uncertainties. (auth)

10195 DISCOVERY OF THE NEW PARTICLE J. Aubert, J. J.; Becker, U.; Biggs, P. J.; Burger, J.; Chen, M.; Everhart, G.; Goldhagen, P.; Leong, J.; Mantsch, P.; McCorriston, T. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Nucl. Phys., B; 89: No. 1-18(14 Apr 1975).

A description is presented of an experiment carried out at the 30 GeV Alternating Gradient Synchrotron of the Brookhaven National Laboratory. The experiment used a high intensity slow extracted proton beam of between 10^{10} and $2 \cdot 10^{12}$ protons per pulse and measured the e^+e^- mass spectrum from the reaction $p + Be \to e^+e^- + X$. The result of this experiment shows the production of a new type of particle, J, which decays to e^+e^- with a width consistent with zero. (auth)

10196 CROSS SECTIONS FOR π^0 FROM ^{3}He ON COMPLEX NUCLEI. Wall, N. S.; Craig, J. N.; Berg, R. E.; Ezrow, D.; Holmgren, H. D. (Maryland Univ., College Park (USA)). pp 279-281 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The cross section for π^0 production by high energy ^{3}He on nuclei was measured. The results are given and compared with theory giving an indication of a large (~10^2) discrepancy. (auth)

10197 PION CHARGE EXCHANGE REACTIONS. Zaider, M.; Alster, J.; Ashery, D.; Auerbach, N.; Cochavi, S.; Moinester, M. A.; Warszawski, J.; Yavin, A. I. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). pp 219-222 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Published calculations and data for pion single charge-exchange are presented and lead to some open questions. The results of measurements of the cross section are reported for the reactions $^{13}C(\pi^+,\pi^0)^{13}N$ and $^{11}B(\pi^+,\pi^0)^{11}C$ over the energy range of 30 to 90 MeV by an activation method. The data for ^{13}C correspond solely to the excitation of the ground state analog. The excitation curve for ^{13}C is flat, in disagreement with available predictions for analog state transitions, using either plane wave or nonlocal optical potentials, but can be explained by a local optical potential. (auth)

10198 DIFFRACTIVE DISSOCIATION OF PIONS AND NEUTRONS AT 15 GeV/c IN π^-d INTERACTIONS. Bastien, P. L.;

Dunn, L. A.; Harris, R.; Lubatti, H. J.; Moriyasu, K.; Podolsky, W. J. (Washington Univ., Seattle (USA). Dept. of Physics); Bingham, H. H.; Chew, D. M.; Fretter, W. B.; Graves, W. R. pp 143-146 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Preliminary results are presented on the diffractive dissociation of pions and neutrons into multiparticle final states. The data are obtained from π^-d interactions at 15 GeV/c in the SLAC 82-inch bubble chamber and are measured on the University of Washington's PEPR system. Pion dissociation is studied in the reaction $\pi^-d \to \pi^-\pi^-\pi^+d$. The well known $A_1(\rho\pi)$ and A_3 ($f\pi$) diffractive enhancements are clearly observed in the 3π mass spectrum. In addition, there is an indication of a mass peak at approximately 1.9 GeV. This new enhancement, called the A_4 ($g\pi$), is the first experimental observation of pion dissociation into a $g\pi$ threshold state. Diffractive dissociation of neutrons is observed in the reaction $\pi^-d \to \pi^-\pi^-pp$. Evidence for two different production mechanisms is seen in the momentum transfer distribution. The low mass $p\pi^-$ events are extremely peripheral (exp (15t')) while the higher masses have a more normal exp (6t') distribution. The low mass behavior is consistent with neutron diffractive dissociation. This conclusion is also supported by the $p\pi^-$ angular distributions. There is some evidence for production of the known N* resonances but only for $t' \geq 0.1$ (GeV/c)^2. (auth)

10199 MEASUREMENT OF 3π MASS SPECTRUM IN THE REACTION $\pi^-{}^{12}C \to \pi^-\pi^-\pi^+C^{12*}$(4.44 MeV). Ascoli, G.; Chapin, T.; Holloway, L. E.; Koester, L. J. Jr.; Kruse, U. E.; Nodulman, L. J.; Wojslaw, R. (Illinois Univ., Urbana (USA)). pp 147-150 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The Argonne Effective Mass Spectrometer was used in a 6-GeV/c beam to measure the 3π mass spectrum in coincidence with the 4.44-MeV C* γ-ray from the reaction $\pi^-C^{12} \to \pi^-\pi^+\pi^-C^{12*}$. Over 2000 good events were obtained. The preliminary mass distribution peaks around the A_1 meson. For these events, the γ flight time distribution excludes neutrons and the missing mass is that of $^{12}C \pm 70$ MeV. The t distribution shows a dip in the forward direction and falls exponentially at large |t| values. On-line analysis yielded an integrated cross section of 0.2 mb for this $3\pi C^*$ production, i.e. 10% of the πC^* single scattering. (auth)

10200 COHERENT PRODUCTION OF $K^+\pi^+\pi^-$ ON NUCLEI AND DETERMINATION OF THE $K^+\pi^+\pi^-$-NUCLEON CROSS-SECTION. Bemporad, C.; Beusch, W.; Dufey, J. P.; Polgar, E.; Websdale, D.; Zaimidaroga, O. (European Organization for Nuclear Research, Geneva (Switzerland)); Fluri, L.; Freudenreich, K.; Gentit, F. X.; Muehlemann, P. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). pp 127-130 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Coherent production of $K^+\pi^+\pi^-$ on nuclei was observed at 10, 13 and 16 GeV/c. The differential cross section is well fitted by an optical model. The $K^+\pi^+\pi^-$ mass distribution shows a structureless Q bump; the K^+ mass was assigned to one of the two positive particles by a K* selection. The total cross section of the $K^+\pi^+\pi^-$ system on a nucleon is found to be 22 mb. (auth)

10201 NEW MEASUREMENTS OF PION-PROTON BREMSSTRAHLUNG IN THE REGION OF THE $\Delta(1236)$ RESONANCE. Nefkens, B. M. K.; Arman, M.; Glodis, P.; Haddock, R. P.; Leung, K. C.; Schrock, B. L.; Sober, D. I.; Sperinde, J. M. (California Univ., Los Angeles (USA)). pp 51-54 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The conspicuous absence of a sizeable peak in the photon spectrum of the reaction $\pi^+p \to \pi^+p\gamma$ due to the $\Delta^{++}(1236)$ resonance, was further investigated. The original measurements were extended to include nine new photon angles so as to cover the full angular range, θ (γ) = 0 to 360°, and to investigate two c.m. energies, $\sqrt{s}$ = 1 306 and 1 275 MeV. As in the original experiment, θ (π) $\simeq -50°$ and θ (p) = 10 to 60°. The photon spectra observed at all angles, for both energies and for π^+ and π^-, are monotonically decreasing with increasing photon energy, and devoid of any significant structure. Thus the hypothesis of an accidental cancellation to explain the absence of a clear $\Delta^{++}(1236)$ peak in the data is shown experimentally to be untenable. (auth)

10202 DETAILED BALANCE IN PION PHOTOPRODUCTION IN THE FIRST RESONANCE REGION. Joseph, C. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 33-40 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Experimental results in photoproduction of negative pions and radiative capture of π^- by protons are reviewed in the context of the existence of an isotensor component of the electromagnetic current of hadrons and of time reversal invariance. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 10416 and 10559.

10203 (CONF-740713-, pp I.83-I.86) MULTIPARTICLE PHYSICS IN THE "BULK LIMIT." Thomas, G. H. (Argonne National Lab., IL). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The bulk of the cross sections at very high energies (i.e. > 100 GeV/c) comes from multiplicities near the average and the main features of this bulk are (i) small $\langle P_T \rangle$, which is roughly energy independent; (ii) a multiplity distribution close to Poisson and (iii) the presence of two leading particles. The situation in which events have small $\langle P_T \rangle$, so that the rapidity variable y gives the primary characterization, is called the "bulk limit". Ideally the maximum rapidity Y should be large and $n \sim \langle n \rangle$, i.e., in the limit $Y \to \infty$ and n/Y fixed. If the generating function is written $\phi(Z) = \Sigma_n \sigma_n z^n$ then the bulk limit corresponds to z fixed and near unity. The most interesting of those properties of the bulk of the data which are new and unexpected are reviewed. The items considered are: rapidity correlations, Regge models for inclusive correlations, cluster models for correlations, semi-inclusive correlations and charge transfer. (UK)

10204 (COO-1545-153) DOMAIN STRUCTURE OF A REGGEON FIELD THEORY WITH THREE COUPLINGS. Geer, K. A.; Pinsky, S. S. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1974. Contract AT(11-1)-1545. 17p. Dep. NTIS $4.00.

The high energy behavior of a Reggeon field theory with a three-Reggeon coupling and two four-Reggeon couplings is considered. Using the renormalization group equations which are calculated in lowest order for this model, one studies the way the couplings evolve to the fixed points in the high energy limit. It was found that there are three fixed points (plus a fourth at infinity) to which the couplings can evolve. The space of couplings divides into four domains, two of which are two-dimensional and two of which are three-dimensional. The couplings in one of the three-dimensional domains are found to evolve to infinity and the couplings in the other three domains are found to evolve to the fixed point couplings. The boundaries of these domains and some characteristic evolution curves are shown. The implications of the domain structure of the model are discussed. (auth)

10205 (FRNC-TH-513) THEORETICAL STUDY OF UNSTABLE PARTICLES. Hittner, D. (Paris-11 Univ., 91- Orsay (France)). 1971. 124p. (In French). INIS.

A critical study is devoted to the correspondence between unstable particles and the poles of the S matrix. The Matthews and Salam hypothesis are verified by means of Lee's model. It is shown that the spectral function associated with an unstable particle reflects its essential properties and can be interpreted as a mass probability distribution intrinsically associated with the particle. (FR)

10206 (WIS-Ph-74/4) MULTIPLE POMERON EXCHANGE AND FINAL STATE RESCATTERING. Schwimmer, A. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). [nd]. 14p. INIS.

3 figs.

The influence of final state rescattering corrections on multiple Pomeron exchange is studied. It is shown in a certain approximation that the multiple exchange of a simple-pole Pomeron violates the Froissart bound even after the inclusion of these corrections. A self-consistent unitarity equation is set up, and it is shown that its solution is an expanding black disk. The multiparticle properties of this solution are discussed. (auth)

10207 (WIS-Ph-74/11) THE NATURE OF PHYSICAL STATES IN THE DUAL RESONANCE MODEL. Collins, P. V.; Friedman, K. A. (Weizmann Inst. of Science, Rehovoth (Israel)). [nd]. 15p. INIS.

2 figs.

The nature of the physical states in the dual resonance model is analyzed carefully. It is argued that the explicit k dependence of the DDF states requires that they should not be identified with the physical states. The operator $\tau(k)$ of Brink and Olive is a projection operator onto the DDF states, which are not covariant representations of the physical states. It is shown under what conditions $\tau(k)$ may be used as a covariant physical state projector operator on the shell. The results are used to show that the dual resonance model has no covariant continuation off shell which retains the spectrum of the physical states. (auth)

10208 (WIS-Ph-74/23) THE POMERON AND OTHER SINGLE DUAL LOOPS WITHOUT UNPHYSICAL STATES. Collins, P. V.; Friedman, K. A. (Weizmann Inst. of Science, Rehovoth (Israel)). [nd]. 17p. INIS.

3 figs.

The single nonplanar dual loop is recalculated in the critical dimension of space-time. This becomes possible because of the recent analysis of the nature of physical states in the dual model which enables one to understand when $\tau(k)$, the on-shell projection operator of Brink and Olive, becomes Lorentz covariant. The "Pomeron" loop is recalculated, and it is shown that the Pomeron becomes a factorizable pole in the critical dimension, as previously conjectured. It is indicated how these results extend to the Neveu–Schwarz model. (auth)

10209 SEARCH FOR CHARM. Gaillard, M.K.; Lee, B.W. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510); Rosner, J.L. Rev. Mod. Phys. 47: No. 2, 277-310 (Apr 1975).

A systematic discussion of the phenomenology of charmed particles is presented with an eye to experimental searches for these states. We begin with an attempt to clarify the theoretical framework for charm. We then discuss the *SU* (4) spectroscopy of the lowest lying baryon and meson states, their masses, decay modes, lifetimes, and various production mechanisms. We also present a brief discussion of searches for short-lived tracks. Our discussion is largely based on intuition gained from the familiar —but not necessarily understood—phenomenology of known hadrons, and predictions must be interpreted only as guidelines for experimenters. (auth)

10210 RELATIVISTIC SECOND-ORDER ENERGY FUNCTIONAL FOR FINITE FERMION SYSTEMS. Bolsterli, M. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. D 11: No. 4, 784-789 (15 Feb 1975).

A second-order energy functional is calculated for a finite system of fermions interacting via meson fields. The positive-type projection operator is utilized to relegate most corrections due to holes to higher than second order. The second-order functional is the basis for the relativistic analog of the Hartree-Fock procedure. (auth)

10211 DRELL-YAN ANNIHILATION PROCESS AND THE PRODUCTION OF THE NEW 3.1- AND 3.7-GeV RESONANCES. Gunion, J.F. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. D 11: No. 7, 1796-1801 (1 Apr 1975).

We investigate the implications of the SLAC data on production and decay of the new 3.1-GeV resonance for the cross section observed at Brookhaven assuming dominance of the Drell-Yan quark-antiquark annihilation mechanism. Consistency of the predicted magnitude with experiment may be obtained, given certain assumptions which shed light on the nature of the new resonance. Corresponding expectations for the 3.7-GeV resonance are discussed. (auth)

10212 MULTI-DETERMINANTAL HARTREE-FOCK THEORY. Shadmon, G.; Kelson, I. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). Nucl. Phys., A; 241: No. 3, 407-428(14 Apr 1975).

Systematic generalizations of the independent particle approximation are introduced. Functionals which describe the qualities of these approximations are defined and investigated. Appropriate equations, obtained by applying the variational principle, are derived, and methods of their solution are outlined. The concept of the Hartree-Fock self-consistent Hamiltonian is generalized. (auth)

10213 THE QUANTIZATION OF A MASSLESS RELATIVISTIC STRING IN A TIME-LIKE GAUGE. Goddard, P.; Ponzano, G. (Institute for Advanced Study, Princeton, N. J. (USA)); Hanson, A. J. (Stanford Linear Accelerator Center, Calif. (USA)). Nucl. Phys., B; 89: No. 1, 76-92(14 Apr 1975).

The massless relativistic string is quantized in a time-like orthonormal gauge. The results are completely equivalent to those obtained in the light-like case. In particular, a strictly canonical quantization procedure succeeds only when the dimension of space-time is 26. The discussion is based on Dirac's formalism for constrained systems and the introduction of classical variables analogous to those defined by Del Giudice, Di Vecchia and Fubini in the dual model. (auth)

10214 PRECOCIOUS SCALING AND DUALITY IN THE QUARK-PARTON MODEL: A REFORMULATION. Einhorn, M. B. (National Accelerator Lab., Batavia, Ill. (USA)); Fox, G. C. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 89: No. 1, 45-75(14 Apr 1975).

In a model of confinement similar to the massive quark model the subjects of precocious scaling and the Bloom-Gilman relation are considered. Precocious scaling with exchange degeneracy among secondary trajectories is identified. By using the annihilation rule, which explains the pattern of exchange degeneracy in hadron reactions, it is shown that $e^-N \to e^-X$ should manifest precocious scaling, as should some other processes such as $e^-e^+ \to \pi^\pm X$, $e^-e^+ \to KX$. In contrast thereto, certain other reactions, such as $e^-e^+ \to h^0X$, which allow an isosinglet missing mass, may not show precocious scaling. Examples include $h^0 = \pi^0, \eta, \omega, \phi$. The predictions of precocious scaling are only as good as the valence quark model and hence, only apply for x sufficiently near to one. For x sufficiently far from one, precocious scaling will not be valid for any reaction. Another consequence is that the total cross section for electron-positron annihilation to hadrons need not scale rapidly. However, in the limit of SU(3) invariance, even this cross section would scale precociously. In this picture, the Bloom-Gilman relation corresponds to having resonances in three quark scattering dual to the pomeron. This relation is shown to be consistent with a generalization of the dual pomeron to quark-quark and quark-antiquark scattering. (auth)

10215 ASYMPTOTIC BEHAVIOUR OF MULTIPLICITIES IN MODELS WITH INTERACTING POMERONS. Caneschi, L.; Jengo, R. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 89: No. 1, 19-31(14 Apr 1975).

Using renormalization group techniques, the asymptotic behavior of $\langle n^p \rangle$ in models with strong coupling pomeron interactions is found to be in $s^{p(1+\gamma)}$. In the Gribov region calculus $\gamma = \eta$ ($\eta = \lim \ln \sigma_T(s)/\ln \ln s$), in an absorptive model $\gamma = -\eta$. The values of $\langle n^p \rangle / \langle n \rangle^p$ are calculated perturbatively. The Gribov model results are shown to be consistent with positivity requirements, and in surprisingly good agreement with experimental values at present energies. (auth)

10216 QUANTITATIVE ANALYSIS OF THE QUARK-PARTON DISTRIBUTIONS. Wada, S. (Tokyo Univ. (Japan). Dept. of Physics). Nucl. Phys., B; 89: No. 1, 170-188(14 Apr 1975).

A quantitative and less model-dependent analysis of the quark parton distributions is attempted. Both the valence-sea (symmetric core) model and the deformed core model are compared in detail with the present data. It is found that the deformed core model is more reasonable if the almost monotonous behavior of the ratio of two valence quarks is assumed. Some properties of the distributions in the wee region, such as the rate of convergence of Adler's neutrino sum rule, Regge behavior and J = 0 fixed pole residues, are investigated. (auth)

Electromagnetic

Refer also to abstracts 10402, 10668, and 10715.

10217 (CONF-740713-, pp II.147-II.150) PARTIAL WAVE ANALYSES OF $\gamma N \to \pi N$. Lyth, D. H. (Univ. of Lancaster, Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Recent results on $\gamma N \to \pi N$ analysis in the resonance region (Berends and Donnachie. (XVII Int. Conf. High Energy Phys., London (1974) Paper 1007). Devenish et al. (Lancaster preprint to be submitted to Phys. Letts.). Knies et al. (Preprint LBL-2410 (1973)). Metcalf and Walker. (Preprint CALT-68. 425 (1974))) are reviewed. The analysis of Berends et al. is an energy-independent partial wave analysis and, with an improved data set over that used in previous analyses, smooth accurate multipoles are obtained. In the other three cases the analyses include the resonances seen in πN scattering with floating couplings together with different types of background. The cases where the background is essentially free, and those where it is generated wholly or partly from the resonances themselves via fixed-t dispersion relations are considered. The different methods of analysis employed are discussed. The results for the γN couplings obtained are tabulated and compared with the quark model. (UK)

10218 (CONF-740713-, pp II.151-II.156) PION PHOTOPRODUCTION IN THE RESONANCE REGION. Rutherglen, J. G. (Univ. of Glasgow). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The principal object of pion photoproduction is to establish the electromagnetic couplings of the nucleon resonances. Five new experiments, the results from which were presented to the XVII International Conference on High Energy Physics, London, 1974, measured various polarization asymmetries (polarized photon, Σ; polarized target, T; recoil polarization, P). The experimental methods are summarized in tabular form. An interesting new technique is the use of the SLAC back-scattered laser photon beam for resonance region physics. The Bonn experiment used a deutrated butanol target for the first measurements of T from polarized neutrons. The Daresbury experiment on $\gamma p \rightarrow \pi^+ n$ is the first double polarization experiment in photoproduction and enabled Σ, T and P to be measured simultaneously. The new data provides a considerable increase in the kinematic region covered by polarization measurements, and this will have a considerable impact on the precision with which the resonance couplings can be deduced from the partial wave analyses. Predictions of the present analyses are compared with the new data. (UK)

10219 (CONF-740713-, pp II.163-II.165) ELECTROPRODUCTION IN THE RESONANCE REGION. Foster, F. (Univ. of Lancaster, Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

In this review recent coincidence experiments in which the scattered electron is detected in coincidence with one of the final state hadrons are considered. An analysis of the cross sections over a range of values of the four momentum transfer squared, k^2, and the hadronic mass, W, gives detailed information on both the transverse and longitudinal excitations of the many π-N partial waves and on transition form factors. First, second and third resonance region data from various groups are discussed. Quark model predictions in the second resonance region and $\pi^-\Delta^{2+}$ production near the threshold are considered. (UK)

10220 (CONF-740713-, pp II.165) PION RADIUS. Adylov, G. T.; Aliev, F. K.; Bardin, D. Yu. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The pion radius has been measured by direct scattering of 50 GeV negative pions from stationary electrons in a hydrogen target. The square of the radius was found to be: $\langle r_\pi^2 \rangle = (0.61 \pm .15) F^2$, $r_\pi = .78^{+.\,.}_{-.\,.} F$. (UK).

10221 (CONF-740713-, pp IV.16-IV.19) FORM FACTORS AND LOW ENERGY DYNAMICS IN e^+e^- ANNIHILATION. Renard, F. M. (Univ., Montepellier, France). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Papers contributed to the XVII International Conference on High Energy Physics, London, (1974) covering the subject of form factors and low energy dynamics in e^+e^- annihilation are reviewed. The contributions are characterized by increased accuracy within the existing models which corresponds closely to similar developments on the experimental side. The main subjects covered are: rigorous properties of the pion form factor (sum rules, bounds, zeroes), developments of the (restricted and extended) vector dominance models, detailed analyses of quasi-body reactions. (UK)

10222 (CONF-740713-, pp IV.20-IV.35) THEORETICAL IDEAS ABOUT $e^-e^+ \rightarrow$ HADRONS AT HIGH ENERGIES. Ellis, J. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Theorists were almost unanimous in predicting that $R(q^2) \equiv \sigma(e^-e^+ \rightarrow \gamma \rightarrow \text{hadrons})/\sigma(e^-e^+ \rightarrow \gamma \rightarrow \mu^-\mu^+)$ would tend to constant $q^2 \rightarrow \infty$, but these predictions have not been borne out in the range $9 < q^2 \leq 25$. This process is discussed in the light of many recent theoretical papers on $e^-e^+ \rightarrow$ hadrons. The points considered are; possible mechanisms, the one-photon mechanism, the naive parton model (approach to scaling in $\sigma_{tot}(q^2)$ and $d\sigma/dx$), modifications to the naive parton model (anomalies, new partons, renormalization group approaches, partons with structure, new parton diagrams), models not based on partons (generalized vector meson dominance models, dual models, other resonance models, phase space or statistical model, thermodynamical or statistical bootstrap model, hydrodynamical model), hadron production without photons (general formulation, s-channel models, t-channel models, other models). It is concluded that it is clear that there is no consensus among theoreticians working on e^-e^+ annihilation—not even about such basic questions as whether or not it proceeds predominately by one photon exchange, or whether or not to use parton ideas. At the moment developments in two directions seem necessary—the experimental exclusion of some of the theoretical alternatives, and finding good theoretical reasons for believing one model rather than another. An extensive bibliography is included. (UK)

10223 (CONF-740713-, pp IV.37-IV.55) PLENARY REPORT ON $e^+e^- \rightarrow$ HADRONS. Richter, B. (Stanford Linear Accelerator Center, CA). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The subject of hadron production in electron positron collisions is reviewed in the light of the five experimental and sixty-one theoretical contributions on the subject to the XVII International Conference on High Energy Physics. London. (1974). The subject is of great intrinsic interest because of what it has to reveal about hadron structure and dynamics and also because the results of recent experiments contradict all previous models of hadron production. Results were expected to be of a certain simple form on the basis of an elementary quark-parton model but the cross sections measured and considered here do not look at all like what was expected. The subject is considered under the headings: QED, hadron total cross sections, inclusive distributions, angular distribution, heavy particle production, exclusive channels, experimental summary, theory (new interactions, patches and fixes to the quark model, hydrodynamic, thermodynamic and phase space models, resonance and vector dominance). (UK)

10224 (CONF-740713-, pp IV.80-IV.85) COMMENTS ON GENERALIZED VECTOR DOMINANCE. Schildknecht, D. (DESY, Hamburg). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

In considering generalized vector dominance (GVD) the main points made were: (1) The low lying vector mesons ρ^*, ω, ϕ form an integral part of the scaling phenomenon. Without the ρ^*, ω, ϕ induced contribution scaling is no longer precocious. (2) Off-diagonal GVD allows for $\sigma_{e^+e^-} \sim 1/s$ together with reasonable hadron physics. Precocity of scaling naturally follows from the smallness of the mass parameter, which sets the scale and is computed to be $m^{-2} = 0.61 mp^2$. $\sigma_{e^+e^-} \sim$ const creates problems and may lead to positive scaling violations for large ω', for q^2 sufficiently large. (3) Off-diagonal transitions can explain possible "photon shrinkage" effects in vector meson electroproduction. (4) Further search for higher mass vector mesons, comparison of $e^+e^- \rightarrow$ hadrons with diffractive photo- and electroproduction in the 100 GeV energy range and more data on large ω' deep inelastic scattering are important to provide further tests of GVD in the near future. (UK)

10225 (CONF-740713-, pp IV.86-IV.88) INCLUSIVE DEEP INELASTIC LEPTOPRODUCTION. Cahn, R. (Univ. of Washington, Seattle). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Despite the apparent adequacy of the quark-parton model for inclusive leptoproduction, its failure in e^+e^- annihilation casts grave doubts on its reliability. It may well be, however, that suitable normalized quantities, e.g. $1/\sigma\, d\sigma/dz$ will be reasonably predicted by the model. Breakdown of scaling is discussed. If one seeks only a phenomenological description recourse to elaborate theories is unnecessary. In contrast with inclusive e^+e^- annihilation data, deep inelastic leptoproduction data available at present are not in conflict with the naive quark-parton model. (UK)

10226 (CONF-740713-, pp IV.149-IV.173) PLENARY REPORT ON DEEP INELASTIC SCATTERING AND THE STRUCTURE OF HADRONS. Gilman, F. J. (Stanford Linear Accelerator Center, CA). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A survey of recent work on deep inelastic scattering and the structure of hadrons is given covering the topics; kinematic and theoretical framework, scaling and its breaking, other characteristics of the leading singularity, the hadronic final state, other deep inelastic processes involving currents (electron-positron annihilation into hadrons, $pp \rightarrow \mu^+\mu^-$ + anything, inelastic Compton scattering). An extensive bibliography is included. (UK)

10227 SCATTERING AMPLITUDES FOR INVERSE BREMSSTRAHLUNG AND PAIR PRODUCTION IN A LASER PULSE. Slaughter, M.D.; Murphy, J.E. (Physics Department, University of New Orleans, New Orleans, Louisiana 70122). Phys. Rev. D 11: No. 6, 1708-1710 (15 Mar 1975).

The scattering amplitudes for the processes of inverse bremsstrahlung and pair production in a laser pulse are given for scattering and nonscattering boundary conditions. (auth)

10228 ELECTROMAGNETIC MASS DIFFERENCES IN THE SU(3) × U(1) GAUGE MODEL. Maharana, K.; Sastry, C.V. (Regional Engineering College, Rourkela-769008, Orissa, India). Phys. Rev. D 11: No. 6, 1711-1713 (15 Mar 1975).

In this note we point out that the electromagnetic mass differences of the pion and kaon in the SU(3) × U(1) model are the same as in Weinberg's model except for the differences in the masses of the gauge bosons. (auth)

10229 ELECTRON-LASER PULSE SCATTERING. Slaughter, M.D. (University of New Orleans, New Orleans, Louisiana 70122). Phys. Rev. D 11: No. 6, 1639-1648 (15 Mar 1975).

We present a formalism for the calculation of scattering amplitudes for electron-laser pulse processes. Our results make use of standard Feynman-Dyson *S*-matrix techniques and the Lehmann-Symanzik-Zimmermann reduction formalism. The laser pulse is described quantum mechanically as a coherent-state wave packet. The electron is represented by wave-packet solutions of the Dirac equation in the case of scattering boundary conditions, or by Volkov wave packets when we desire nonscattering boundary conditions. We demonstrate the existence of new, nonlinear corrections of a quantum-mechanical nature for the process of stimulated Compton scattering. (auth)

10230 ELECTRON-ELECTRON SCATTERING. III. HELICITY CROSS SECTIONS FOR ELECTRON-ELECTRON SCATTERING. DeRaad, L.L. Jr. (Department of Physics, University of California, Los Angeles, California 90024); Ng, Y.J. Phys. Rev. D 11: No. 6, 1586-1590 (15 Mar 1975).

The helicity amplitudes for electron-electron scattering to order e^4 are calculated by using the five invariant amplitudes presented in a previous paper. As applications, we rederive the unpolarized cross section given by Polovin and the spin-momentum correlation result obtained by Barut and Fronsdal. (auth)

10231 THE HADRONIC STRUCTURE OF THE PHOTON WITH EMPHASIS ON ITS TWO-PION CONSTITUENT. Yennie, D.R. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850). Rev. Mod. Phys. 47: No. 2, 311-330 (Apr 1975).

The hadronic structure of photons is studied by treating the electromagnetic interaction in lowest order. General consequences of this picture and its connection with generalized vector meson dominance for diffractive processes are discussed. Emphasis is given to the dipion constituent which can be regarded approximately as a superposition of two parts: a ρ^0-meson core and a loose nonresonant two-pion structure. This modification of VMD increases the dipion contribution to the real photon cross section by 10%-20% (of the ρ^0 part) and to νW_2 by several percent. The internal spatial structure of this component is shown to shrink as the photon becomes more virtual. Various views of diffractive pion pair photoproduction are reconciled. The Drell process is interpreted in terms of the dipion component and some evidence is given for its presence in inclusive π^--photoproduction data. Some speculations about the consequences of the spatial size of different photon constituents are given. (auth)

10232 LOW-ENERGY COMPTON SCATTERING: THE MAGNETIC POLARIZABILITY OF THE NUCLEON. Ragusa, S. (Department de Física e Ciência dos Materiais, Instituto de Física e Química de São Paulo, Universidade de São Paulo, 13560-São Carlos-SP-Brasil). Phys. Rev. D 11: No. 6, 1536-1541 (15 Mar 1975).

An expression for the magnetic polarizability of the nucleon is derived using gauge and relativistic invariance. Besides the well-known term that contains products of magnetic dipole transition moments it is shown that there exists a second contribution related to third moments of the current-charge density commutator. An estimation of the proton magnetic polarizability leads to a result which is consistent with the available experimental value. (auth)

10233 VIOLATIONS OF BJORKEN SCALING IN INCLUSIVE e^+e^- ANNIHILATION. Callan, C.G. Jr.; Goldberger, M.L. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 6, 1542-1552 (15 Mar 1975).

We discuss the application of renormalization-group techniques to inclusive e^+e^- annihilation. It is shown by a modest extension of Mueller's techniques that annihilation structure functions have a behavior completely analogous to electroproduction structure functions: Their moments scale for large virtual photon mass, and this scaling is described by "anomalous dimensions" which have a singularity structure and general form very similar to the usual anomalous dimension, though there is no simple relation between the two. We show how information about the structure functions can be deduced from the moments and how, in appropriate limits, deviations from Bjorken scaling can be interpreted in terms of an underlying field theory. (auth)

10234 MODEL CALCULATIONS OF ELECTROPRODUCTION AND INCLUSIVE ANNIHILATION CROSS SECTIONS. Callan, C.G. Jr.; Goldberger, M.L. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 6, 1553-1562 (15 Mar 1975).

We have studied "deep-inelastic electroproduction" and "inclusive e^+e^- annihilation" in massless ϕ^4 theory in the ladder approximation. The relevant Bethe-Salpeter-type equations can be completely solved and the physically important asymptotic limits are studied. The behavior of the moments of the structure functions is analyzed, and the "anomalous dimensions" which govern the asymptotic power behavior of the moments in the two cases are found. The anomalous dimensions are quite different in general, but are simply related in the weak-coupling limit. (auth)

10235 ACCELERATION OF CHARGED PARTICLES AND RADIATION REACTION. III. Motion in Pulsar Vacuum Fields. Grewing, M.; Schruefer, E. (Bonn Univ. (F. R. Germany). Inst. fuer Astrophysik und Extraterrestrische Forschung); Heintzmann, H. (Koeln Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Phys., B.; 20: No. 1, 123-129(1975).

An analytic solution is derived for particle motion in strong, linearly polarized spherical waves for the case of negligible radiation reaction. If the radiation reaction is included the initial part of the motion can also be described analytically, whereas the further motion is obtained from a numerical integration of the equation of motion. (auth)

10236 BARYON MASS DIFFERENCES IN A HYBRID GAUGE MODEL OF STRONG AND ELECTROMAGNETIC INTERACTIONS. Huq, M. (Department of Mathematical Physics, University College, Dublin, Ireland); Acharya, R. Phys. Rev. D 11: No. 5, 1267-1271 (1 Mar 1975).

We calculate all the baryon mass differences in the single-loop approximation in a gauge model of strong and electromagnetic interactions. The model is a hybrid version of the Georgi-Goldman model. We obtain good agreement with experimental values. (auth)

10237 STATISTICAL CONSIDERATION OF ISOTOPIC SPIN IN HIGH-ENERGY COLLISIONS. Yao, Y. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 11: No. 5, 1298-1308 (1 Mar 1975).

For a given isospin I, charge q, and definite numbers of π's, K's, $\bar{K}$'s, etc., many independent charge combinations of the particles can be made. If one assigns equal *a priori* probability to each combination, then explicit solutions for all the multiparticle correlation functions can be given. Although the formulation is general, we specialize to systems containing pions and $K\bar{K}$ pairs only. This is further exemplified by applying it to states with $I = 0,1$ and $q = 0$, which are relevant to the process $e^+ + e^- \to$ hadrons. (auth)

10238 QUARK-PARTON MODELS AND THE NEUTRON CHARGE RADIUS. Fishbane, P.M.; McCarthy, J.S.; Noble, J.V.; Trefil, J.S. (Physics Department, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. D 11: No. 5, 1338-1340 (1 Mar 1975).

We point out that in parton models of nucleons, including standard constituent-quark models, the nonvanishing of the neutron charge radius implies an essential mixing of the space part of the nucleon wave function with those parts involving isospin and other discrete quantum numbers. We state these conditions precisely, and give a new value for this charge radius, derived from precise electron-deuteron scattering data. (auth)

10239 THEORETICAL IMPLICATIONS OF THE RESONANCE ANOMALIES IN THE e^+e^- SYSTEM. Pakvasa, S.; Rajasekaran, G.; Tuan, S.F. (Department of Physics and Astronomy, University of Hawaii, Honolulu, Hawaii 96822). Phys. Rev. D 11: No. 5, 1345-1350 (1 Mar 1975).

The phenomenological properties of the recent resonance anomalies at 3.1 GeV and 3.7 GeV in e^+e^- systems are confronted in a fairly systematic way with models presently known to us. These include charm-related models, neutral-intermediate-boson-type hypotheses, gauge-related models, and exotic suggestions that the resonant states may have abnormal C parity or that the electromagnetic current has a color triplet piece. We conclude that none of the schemes proposed represents a really satisfactory interpretation of the data. (auth)

10240 SINGLE-PARTICLE INCLUSIVE ELECTROPRODUCTION IN ASYMPTOTICALLY FREE THEORIES. Ahmed, M.A. (Department of Theoretical Physics, 12 Parks Road, Oxford OX1 3PQ, England). Phys. Rev. D 11: No. 5, 1362-1367 (1 Mar 1975).

We investigate single-particle inclusive electroproduction in asymptotically free gauge theories of the strong interactions. The key tool in making this possible is Regge asymptotic behavior, which enables us to express the cross section for single-particle inclusive electroproduction in terms of the amplitude for Compton scattering on a

"Reggeon" target. Sum rules for moments of the structure functions are derived. (auth)

10241 NEW BOUND ON THE PION'S CHARGE RADIUS. Pham, X.Y.; Wright, A.C.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 11: No. 7, 1806-1811 (1 Apr 1975).

A new bound for the pion form factor in the timelike and spacelike regions is derived and evaluated with the help of timelike data. The bound is compared with recent Serpukhov-UCLA data near $t = 0$, and implications for the asymptotic behavior of the form factor and for the pion's charge radius are discussed. (auth)

10242 ASYMPTOTIC BEHAVIOR OF FORM FACTORS FOR TWO- AND THREE-BODY BOUND STATES. II. Spin-1/2 CONSTITUENTS. Alabiso, C.; Schierholz, G. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 11: No. 7, 1905-1914 (1 Apr 1975).

The asymptotic behavior of form factors for two- and three-particle bound states is investigated in the case of spin-1/2 constituents in order to shed some light on the underlying structure of the pion and nucleon. Here the Blankenbecler-Sugar approach proves to be a powerful tool for studying dynamics at infinite momentum. For a two-body interaction which for large momentum transfer behaves as $V(q, k) \simeq [(q - k)^2]^{-1-\Delta}$ we obtain for the two- and three-body form factors $F_2 \simeq (Q^2)^{-3/2-\Delta}$ and $F_3 \simeq (Q^2)^{-3-2\Delta}$, respectively, in the case of scalar and pseudoscalar couplings and $F_2 \simeq (Q^2)^{-1-\Delta}$ and $F_3 \simeq (Q^2)^{-3-2\Delta}$ for the vector coupling. The experimental pion and nucleon form factors are, e.g., consistently recovered by assigning a quark-antiquark and three-quark structure to the pion and nucleon, respectively, and assuming that the quarks interact via vector-gluon exchange (i.e., $\Delta \to 0$). (auth)

10243 W-BOSON PAIRS: THEIR PHOTOPRODUCTION AND DECAY TO LEPTONS. Sathe, A.P. (Physics Department, Columbia University, New York, New York 10027). Phys. Rev. D 11: No. 7, 1940-1952 (1 Apr 1975).

We have studied the photoproduction of W pairs, evaluating explicitly the amplitudes for various spin states of the W's and obtained the total cross section for various energies of the incident photon. Also, for an assumed value of the anomalous moment of the W equal to one, the W bosons tend to be transversely polarized. Further, the leptonic decay of the W pair is calculated including the effects of interference between different spin states of the two W bosons. The differential cross section with respect to the transverse component of the sum of the laboratory momenta of the two decay charged leptons is obtained. It is found that even for high values of this momentum component, the differential cross section decreases with increasing assumed mass of the W. Also, the differential cross section is very similar to that which would be obtained if two W's decayed isotropically and independently of each other. (auth)

10244 DEEP-INELASTIC STRUCTURE FUNCTIONS IN AN APPROXIMATION TO THE BAG THEORY. Jaffe, R.L. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 11: No. 7, 1953-1968 (1 Apr 1975).

A cavity approximation to the bag theory developed earlier is extended to the treatment of forward virtual Compton scattering. In the Bjorken limit and for small values of ω ($\omega \equiv |2p \cdot q/q^2|$) it is argued that the operator nature of the bag boundaries might be ignored. Structure functions are calculated in one and three dimensions. Bjorken scaling is obtained. The model provides a realization of light-cone current algebra and possesses a parton interpretation. The structure functions show a quasielastic peak. The spreading of the structure functions about the peak is associated with confinement. As expected, Regge behavior is not obtained for large ω. The "momentum sum rule" is saturated, indicating that the hadron's charged constituents carry all the momentum in this model. νW_L is found to scale and is calculable. Application of the model to the calculation of spin-dependent and chiral-symmetry–violating structure functions is proposed. The nature of the intermediate states in this approximation is discussed. Problems associated with the cavity approximation are also discussed. (auth)

10245 ARE THERE RESCATTERING CORRECTIONS TO INCLUSIVE REACTIONS?. Einhorn, M.B. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510); Henyey, F.S. Phys. Rev. D 11: No. 7, 2009-2012 (1 Apr 1975).

We construct and solve a model for multiparticle production which obeys unitarity exactly. We find, in agreement with some earlier results, that there are no rescattering corrections to inclusive production in this model. We examine the assumptions which lead to this result, and we discuss the consequence of this result to the phenomenology of the parton model. We find that, in a wide class of factorizable models, the inclusive cross section for heavy-virtual-photon emission is independent of the strong interactions. (auth)

10246 NON-NUMERICAL METHODS AND THEIR APPLICATIONS IN ELEMENTARY PARTICLE PHYSICS. Mack, D. Tuebingen, Ger.; Univ. Tuebingen (8 Mar 1973). 85p. (In German). INIS.

Thesis.

Using the computer language LISP and the program REDUCE, electron-electron bremsstrahlung and the Pade approximation are calculated. (auth)

10247 IMPROVED UPPER LIMIT FOR PHOTOPRODUCTION OF ψ (3105) NEAR THRESHOLD. Andrews, D.E.; Harvey, J.; Lobkowicz, F.; May, E.N.; Nelson, C.A. Jr.; Thorndike, E.H. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627); Nordberg, M.E. Jr. Phys. Rev. Lett. 34: No. 17, 1134-1136 (28 Apr 1975).

An improved upper limit for ψ photoproduction near threshold is presented. (auth)

10248 ARE THE NEW e^+e^- RESONANCES ORDINARY HADRONS?. Everett, A.E. (Department of Physics, Tufts University, Medford, Massachusetts 02155). Phys. Rev. Lett. 34: No. 18, 1187-1189 (5 May 1975).

I consider the possibility that the newly discovered e^+e^- resonances are members of a new class of heavy particles, distinct from the hadrons, whose interactions among themselves and with the hadrons are fundamentally different from the usual strong interactions. Experimental implications of such a picture, especially as contrasted with a charmed-quark model, are discussed. (auth)

10249 COULOMB PRODUCTION. Stodolsky, L. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). pp 114-117 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Production induced in the Coulomb field by high energy particles is briefly reviewed. An extension of the method that can be used to find total cross sections of elementary particles with the photon is stressed. (auth)

10250 NEW RESULTS ON DEEP INELASTIC PROCESSES FROM GENERALIZED VECTOR DOMINANCE. Gounaris, G. J. (Ioannina Univ. (Greece). Dept. of Physics). Nucl. Phys., B; 88: No. 3, 451-476(7 Apr 1975).

A formulation of generalized vector dominance (GVD), consistent with the parton model (PM) for deep inelastic electroproduction, is presented. The parton distributions at small x are correctly predicted in terms of the photoabsorption parameters. It is found that no charmed partons exist in the sea of the nucleon. The pomeron–ψ_c coupling and the ψ_c–photoproduction cross section are negligible. The ratio σ_L/σ_T for deep inelastic and diffractive electroproduction is found to be small. This is related to the prediction that the highest Regge singularity coupled to longitudinal vector mesons is a cut with intercept minus one. In the time-like region it implies that the angular distribution in $e^+e^- \to \pi + X$ is $\sim(3-\cos^2\Theta)$, in consistence with experiment and disagreement with PM. Finally the large value of $\sigma(e^+e^- \to \text{hadrons})$ is attributed to a series of ψ_c's. (auth)

10251 DELBRUECK SCATTERING AND TESTS OF THE ELECTRON PROPAGATOR. Kraus, J. (Muenchen Univ. (F. R. Germany). Sektion Physik). Nucl. Phys., B; 89: No. 1, 133-154(14 Apr 1975).

There are straightforward experiments which test the propagator of the photon. In contrast to that, analogous measurements for the electron do not yield any information on the propagator, since gauge invariance of quantum electrodynamics causes essential compensations. Nevertheless, photon–photon interactions are sensitive to modifications of the fermion propagator. Therefore, Delbrück scattering in all orders of $Z\alpha$ is discussed as a possible test of the electron propagator, and it is shown that high energy measurements may extend present knowledge by at least one order of magnitude. (auth)

10252 GAUGE INVARIANCE AND THE ELECTROMAGNETIC INTERACTIONS OF HADRONS. Noga, M. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Nucl. Phys., B; 89: No. 1, 155-169(14 Apr 1975).

The algebraic realization of dynamical symmetry proposed by Weinberg is carried out for gauge symmetry of electromagnetic interactions of hadrons. The derived algebraic realization of gauge symmetry imposes strong algebraic constraints on matrix elements of the electromagnetic current and allows one to calculate the electromagnetic properties of hadrons to all orders of strong interactions and to first order in electromagnetism. Magnetic moments and partial decay rates are calculated for those baryons for which these quantities are measured, and find very good agreement with experiment. (auth)

10253 RESOLUTION OF THE APPARENT DISCREPANCY IN THE MAGNETIC FORM FACTOR OF THE DEUTERON. Rand, R. E.; Yearian, M. R. (Stanford Univ., Calif. (USA). High-Energy Physics Lab.); Buchanan, C. D. (California Univ., Los Angeles (USA). Dept. of Physics). pp 336-339 of High-Energy Physics

and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A long standing discrepancy between theory and the highest momentum-transfer data on the magnetic form factor of the deuteron was resolved following a suggestion of Bethe. The source of the discrepancy is found in the original phenomenological fit to the neutron magnetic form factor data available at that time. This fit showed G_{MN}/μ_N greater than G_{MP}/μ_P by about 12% in the momentum transfer region of interest. Data from C.E.A. now show good evidence for the scaling of nucleon form factors in this region, i.e.: $G_{EP} = G_{MP}/\mu_P = G_{MN}/\mu_N$. There is also evidence now that $G_{EN} = 0$ as was originally assumed. The theoretical deuteron magnetic form factor was recalculated using scaling with the dipole nucleon form factor, $G_{EN} = 0.05$ and the Hamada-Johnston model of the deuteron with 7% D-state. The result agrees exceedingly well with all the data up to $q^2 = 14$ fm^{-2}, without the necessity of postulating scattering from meson exchange currents. This is a very satisfactory situation since the electric form factor is equally well described by essentially the same assumptions. However the static magnetic moment anomaly is still not resolved. (auth)

Weak

Refer also to abstract 10395.

10254 (CONF-740713-, pp III.3-III.10) SECOND CLASS CURRENTS IN NUCLEAR PHYSICS WEAK INTERACTIONS. Garvey, G. T. (Princeton Univ., NJ). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Recent experiments carried out to search for second class currents in weak interactions are described and the results discussed. Effects of induced currents on decay rates and angular correlation are considered. With the emergence of correlation experiments sensitive to the effects of induced weak currents more about this subject should be learned over the next few years. (UK)

10255 (CONF-740713-, pp III.10-III.14) WEAK INTERACTIONS IN ATOMS AND NUCLEI. Jarlskog, C. (Inst. of Theoretical Physics, Goteborg). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The possible weak interaction effects and the possibilities of measuring neutral currents, in atomic physics, are considered. Division of atoms into leptonic, semileptonic and nonleptonic or hadronic (exotic) atoms is discussed. Neutral currents in leptonic and semileptonic atoms, the effects of the parity conserving interaction Hamiltonian $H_I^{p.c.}$, the effects of parity violating weak interactions $H_I^{p.v}$, and the magnitude of parity violation in atoms, are considered. A brief summary of the present status of parity violation in nuclei is added. It is concluded that in many cases there is serious discrepancy between theory and experiments and more theoretical and experimental work is needed to clarify the situation. (UK)

10256 (CONF-740713-, pp III.14-III.15) NEUTRAL CURRENT AND SIGN OF THE WEAK COUPLING CONSTANT. Are Neutrinos Always Left Handed? Kayser, B. (National Science Foundation, Washington, DC). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Two papers presented to the XVII International Conference on High Energy Physics, London. (1974), (Bilenky et al. Neutral Current and Sign of the Weak Coupling Constant. Paper 827. and Fischback et al. Are Neutrinos always Left Handed? Paper 608), which deal with the properties of the neutral weak interactions and their possible use, are considered. Bilenky et al. have used the method of measuring the interference of the neutral weak interaction with the electromagnetic interaction to determine the relative sign of the corresponding coupling constants and combining this with a measurement of the relative sign of the charged and neutral weak couplings to obtain the sign of the Fermi coupling constant. In the second paper, the question of whether the left handedness of the neutrinos is a consequence of the specific form of the charged weak hamiltonian or rather an intrinsic property of the particle being tested experimentally, is explored. (UK)

10257 (CONF-740713-, pp III.16-III.21) MEASUREMENTS OF THE K/sub L/ $\rightarrow \pi^+\pi^-\pi^0$ MATRIX ELEMENT. Nauenberg, U. (Univ. of Colorado, Boulder). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Experiments carried out by three groups of collaborators to measure the structure of the $K_L \rightarrow \pi^+\pi^-\pi^0$ matrix element, whose results were presented to the XVII International Conference on High Energy Physics, London (1974) are discussed. The BSS collaboration (Paper 325) presented preliminary results based on 13,700 events and their data are shown as a function of the pion kinetic energy and fitted to a linear slope. The SSD group (Paper 638) presented their results on a final sample of 32,000 events and since they had no timing information they had two solutions to the π^0 momentum in the K_L center of mass system. Their results are shown as fits in terms of a low and a high momentum solution. The SSC results (Paper 255) consisted of an analysis of 560,000 decays after all cuts. The salient features of the experimental set-up where: (1) Measurement of the K_L momentum by time of flight and (2) A very high and slowly varying detection efficiency across the Dalitz Plot due to the large aperture magnet. The data was fitted with a matrix element consisting of 2 independent variables; $X = \sqrt{3}(T_{\pi^+} - T_{\pi^-})Q$ and $Y = (3T_{\pi^0} - Q)/Q$ where T is the c.m. kinetic energy of the pion and Q is the energy released in the decay. From examining the results it is seen that a quadratic fit is needed. From the results of a quadratic fit it is seen that the data are compatible with a matrix element linear in Y and with an X^2 dependence of opposite sign. (UK)

10258 (CONF-740713-, pp III.76-III.81) GAUGE THEORIES AND WEAK INTERACTIONS. Gaillard, M. K. (Fermi National Accelerator Lab., Batavia, IL). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Gauge theories of both strong and weak interactions allow one to calculate measurable quantities with a degree of confidence which was previously lacking. Recent progress along these lines is reported, including: (1) Conventional radiative corrections to μ- and β- decay. (2) Induced neutral currents in K-decay and constraints on charmed quark masses. (3) Electromagnetic and weak mass shifts. (4) Non-leptonic interactions. (UK)

10259 (CONF-740713-, pp IV.131-IV.148) PLENARY REPORT ON NEUTRINO PHYSICS. Cundy, D. C. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A survey of recent work in neutrino physics is given covering the topics: Neutral current searches; inclusive searches, neutral current searches in specific channels. Charged current interactions; total cross sections, differential distributions, precocious scaling. Search for new particles; heavy lepton searches, charm searches. It is concluded that: ν_μ beams can interact with matter without producing a muon; at present no evidence exists for not attributing them to neutral currents rather than something more exotic; the structure of the neutral current has yet to be determined; the behaviour of charged-current interactions is compatible with what one would expect from "scaling"; the "precocious scaling" observed at low energy is surprising (it could be trivial, but it certainly needs an explanation); as yet no new particle has been "discovered" though many could have been produced. (UK)

10260 DIRECT PRODUCTION OF LEPTONS. Lederman, L. M. (Columbia Univ., NY). Comments Nucl. Particle Phys.; 6: No. 2, 55-57(Apr 1974).

New results that have emerged during early 1974, related to the observation of leptons produced in high energy proton collisions, are reviewed. By "direct" is meant not products of $\pi^\pm$, π^0, $K^\pm$ or K^0, or hyperon decay, but products presumably representing a real or virtual very short-lived parent state. Candidates for such a parent are discussed, together with experimental work. 11 references. (UK)

10261 K/sub 13/ FORM FACTORS AND (8,8) MODEL OF CHIRAL SYMMETRY BREAKING. Ali, Ahmed (Stevens Inst. of Tech., Hoboken, N. J.); Razmi, M. S. K. Ann. Phys. (N. Y.); 89: No. 2, 441-450(Feb 1975).

K/sub 13/ form factors are calculated in the single particle approximation to the spectral functions. The so-called sigma terms and current divergences are calculated in the (8,8) model of chiral symmetry breaking. Comparison with the experimental results and the (3,3*) + (3*,3) model is made. It is concluded that it is not possible to rule out the (8,8) model in favor of the (3,3*) + (3*,3) model at present. (auth)

10262 TESTS OF COUPLING TYPES IN WEAK MUONLESS REACTIONS. Kingsley, R.L.; Shrock, R.; Treiman, S.B.; Wilczek, F. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 5, 1043-1047 (1 Mar 1975).

Various experimental tests are discussed that might serve to reveal the space-time structure of the interactions responsible for weak processes of the type ν ($\bar{\nu}$) + hadron $\rightarrow \nu$ ($\bar{\nu}$) + hadrons. (auth)

10263 *U*-SPIN-INVARIANT MODEL FOR THE NEUTRAL HADRONIC CURRENT. Mathur, V.S.; Okubo, S.; Kim, J.E. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 11: No. 5, 1059-1070 (1 Mar 1975).

A heuristic argument is presented which suggests that the neutral hadronic weak current should transform as a *U*-spin scalar. A model for the neutral current is constructed from a *U*-spin-invariant combination of vector and axial-vector currents, and the relationship of this model to some gauge-theory and other phenomenological models is discussed. The data from neutrino-induced neutral-current experiments are analyzed in some detail. (auth)

10264 ANOMALOUS LEPTON-HADRON INTERACTIONS AND GAUGE MODELS. Pati, J.C. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742); Salam, A. Phys. Rev. D 11: No. 5, 1137-1154 (1 Mar 1975).

Parameters for anomalous lepton-hadron interactions (like their signs, *V* and *A* character, and allowed and forbidden nature of certain transitions) are abstracted from the class of gauge models proposed earlier by the authors. This information is used to determine the strength of the anomalous interactions by fitting e^-e^+-annihilation data. We then make quantitative estimates of the energy dependence of this cross section, the deviation of the ratio of (e^+p/e^-p) cross sections from unity at high q^2, and (apparent) deviations from scaling in *ep* scattering. Also discussed are consequences of anomalous interactions (with the restrictions mentioned above) on enhanced lepton production in hadronic collisions, hyperfine structure splitting in hydrogen, and leptonic decay modes of π^0 and η. On the theoretical side, we discuss variants of the basic gauge model which allow the anomalous lepton-hadron interactions to be relevant at present energies. An analysis of the data involving e^+ alone inclines one to the view that the electron is likely to be "strange" if its interaction with hadrons is "anomalous" at present energies. Further data are needed to test this possibility and also whether the muon and the electron neutrino are anomalous and whether parity is conserved in these anomalous lepton-hadron interactions. It may, of course, be that leptons do possess anomalously strong interactions but only at high energies proposed in our basic gauge model, in which case such interactions are irrelevant for SLAC energies. Several intriguing consequences of the maximal $SU(16)_L \times SU(16)_R$ local symmetry are mentioned. (auth)

10265 NEUTRINO RADIATION PRESSURE ARISING FROM A SCALAR WEAK NEUTRAL COUPLING. Adler, S.L. (The Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 5, 1155-1157 (1 Mar 1975).

We calculate the neutrino radiation pressure arising from coherent neutrino-nucleus scattering induced by a scalar weak neutral coupling. A comparison with the radiation pressure induced by a vector weak neutral coupling shows that, for equal peak $\nu_\mu p$ scattering cross sections in the high-energy region, the scalar coupling is more than a factor of 10 more effective than the vector coupling in producing neutrino radiation pressure at low energies. (auth)

10266 REVISED VALUE FOR THE $\pi \rightarrow e\nu$ BRANCHING RATIO. Bryman, D.; Picciotto, C. (Tri-University Meson Facility and Department of Physics, University of Victoria, Victoria, British Columbia, Canada). Phys. Rev. D 11: No. 5, 1337-1337 (1 Mar 1975).

Using the current value for the pion lifetime, we have recomputed the branching ratio for $\pi \rightarrow e\nu$ decay obtained from the 1963 experiment of Di Capua *et al.* and find $\Gamma(\pi \rightarrow e\nu + \pi \rightarrow e\nu\gamma) / \Gamma(\pi \rightarrow \mu\nu) = (1.274 \pm 0.024) \times 10^{-4}$, a change of 2%. The theoretically predicted value lies within two standard deviations, compared to the 1/2 standard deviation reported previously. (auth)

10267 APPLICATION OF THE IMPROVED RENORMALIZATION GROUP TO $e^+e^- \rightarrow$ HADRONS. Yu, L.P.; Galayda, J. (Department of Physics, Rutgers, The State University, New Brunswick, New Jersey 08903). Phys. Rev. D 11: No. 7, 1930-1934 (1 Apr 1975).

Using the technique of the improved renormalization group, we calculate the mass-insertion correction to the scale invariance of $R(q^2) \equiv \sigma(e^+e^- \rightarrow x) / \sigma(e^+e^- \rightarrow \mu^+\mu^-)$. Under certain simplified assumptions, we find that $R(q^2)$ takes the form $\Sigma_i Q_i^2[a - b_i(q^2)^{-1-c}]$, where a, b_i are positive constants or slowly varying functions of q^2, and $c = 0$ for asymptotically free gauge theory, $c > 0$ for gauge theory with an ultraviolet-stable fixed point near the origin. Adopting a delayed-scaling hypothesis for products of hadron currents in the vacuum, this form of $R(q^2)$ explains the rising $R(q^2)$ observed in CEA and SPEAR I, and provides a clean distinction between these two classes of theories. (auth)

Strong (General)

Refer also to abstracts 10385, 10658, and 10683.

10268 (CONF-740713-, pp I.86-I.90) MULTIPLICITY DISTRIBUTIONS. Fialkowski, K. (Jagellonian Univ., Krakow). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Papers submitted to the XVII International Conference on High Energy Physics, London (1974) covering work on multiplicity distributions are reviewed under two headings: new data, and new results in phenomenological analysis. Data considered include π^-p results at 100 GeV/c, π^+p data at 200 GeV/c, updated pp data at 200 and 300 GeV/c, π^+p data at 100 GeV/c, pp data at 22.4 and 14.75 GeV/C, cosmic ray data at about 10,000 GeV, and results for charge-neutral correlations at very high energy (69, 200 and 300 GeV/c) in pp collisions, including first estimates of neutral particle MD. As far as the models are concerned it is concluded that no really new ideas seem to appear. (UK)

10269 (CONF-740713-, pp I.93-I.118) HIGH ENERGY INCLUSIVE REACTIONS. Zalewski, K. (Inst. of Nuclear Physics, Krakow). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A review article covering recent work on high energy inclusive reactions is presented in four parts. (1) Single particle distributions; approach to scaling, central region, and fragmentation regions. (2) Other distributions; short range correlations, clusters and fireballs, and long range correlations. (3) Special mechanisms; diffractive dissociation, pionization, and annihilation. (4) Scattering on nuclei; coherent production processes, and general production processes. A comprehensive bibliography of 169 references is included. (UK)

10270 (CONF-740713-, pp I.119-I.124) QUARK CONFINEMENT AND THE STRUCTURE OF HADRONS IN FIELD THEORY. Yan, T. M. (Corpell Univ., Ithaca, NY). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Work is reported on a canonical field theory model of hadrons with quark constituents. The approximate quark confinement scheme due to Nambu (Preludes in Theoretical Physics. A. de Shalit et al. (Ed). North Holland Pub. Co. p.133 (1966)) is used to overcome the basic problem for any model of hadrons, that is how to confine the quarks so that isolated quarks will not be produced. It is shown that a relativistic field theory model for hadrons can lead to nonrelativistic SU(6)-like results. Predictions from the model agree well with experiment except for the value of the axial vector current coupling. (UK)

10271 (CONF-740713-, pp I.125-I.131) LARGE p/sub T/ THEORIES. Gunion, J. F. (Univ. of Pittsburgh). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The principle support for naive composite theories of the hadron has come from the scattering processes at large transverse momenta. Within the constituent interchange model (CIM) a fairly tight framework is capable of unifying and describing a large body of experimental facts. The topics discussed in relation to this model include form factor calculations, exclusive fixed angle scattering, high p_T inclusive reactions, and multiplicity distribution opposite the observed high p_T particle. The possible modification of the naive predictions presented here in more sophisticated models of the hadronic interactions, in particular in asymptotically free theories, is considered. (UK)

10272 (CONF-740713-, pp I.131-I.135) DUAL STRINGS. Chang, L. N. (Univ. of Pennsylvania, Philadelphia). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The string model interpretation of the dual resonance model is reviewed. An attempt at providing a dynamical basis for the string is then made by examining certain classical solutions of field theories. A simple model exhibiting the collective motion of constituent particles explicitly is studied. (auth)

10273 CONF-740713-, pp I.136-I.140) REGGEON FIELD THEORY: MOTIVATION AND SOME DEVELOPMENTS. Abarbanel, H. D. I. (National Accelerator Lab., Batavia, IL). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Background material for the recent progress in the study of interacting Reggeons and the determination of the high energy behavior of elastic amplitudes and total cross sections is discussed. (UK)

10274 (CONF-740713-, pp I.140-I.143) STRONG COUPLING, UNITARITY AND INCLUSIVE REACTIONS. Migdal, A. A. (Inst. for Theoretical and Experimental Physics, Moscow). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

It is shown that the problem of the pomeron interaction should be revised, that the weak coupling hypothesis should be rejected and that the natural solution is strong coupling followed by the screening phenomenon, i.e. by suppression of interaction amplitudes due to particle repulsion. The ϵ-expansion method is applied to pomeron interactions and on its basis a simple solution of the problem corresponding to both the pomeron strong coupling at $r^2\xi \geq 1$ and the recently established scaling property is obtained. This solution in the region $r^2\xi \geq 1$ smoothingly matches with the perturbation theory series and possesses physically reasonable properties. A rigorous proof of the s-channel unitarity of the solution was not found but it does not contain those discrepancies which exist in the weak coupling solution. Pomeron interactions are described using a Lagrangian, whose perturbation expansion exactly reproduces the contribution from all reggeon Gribov graphs. (UK)

10275 (CONF-740713-, pp I.144-I.149) ABSORPTIVE EFFECTS AND CONSISTENCY. Ciafaloni, M.; Marchesini, G. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The recent trend of absorptive models of diffraction scattering has been to include some t-channel iteration, besides enforcing s-channel unitarity. Results discussed are: (1) Many-channel eikonal models can give rise to an asymptotic grey disc of factorised opacity and universal radius, and do not require saturation of the Froissart bound. (2) Final state absorption models admit pole-like solutions if the renormalised intercept $\alpha(0) = 1$, i.e., if $\alpha_0(G^2,\Delta) = 1 + g_0^2/\Delta$. Since the bare intercept α_0 and the 3π coupling g_0 are given in principle in terms of low energy coupling strength G and Scale Δ, this is actually a constraint, perhaps connected with t-channel unitarity, in order to avoid solutions of type (1). (3) The repulsive interactions due to elastic re-scattering in the final state affect the energy dependence ($\sigma_{tot} \sim \beta_A\beta_B (\ln s)^{\eta}$) but only mildly the multiplicity distribution. If g_0 is the observed 3π coupling g_p ($\sim$½GeV^{-1}), then most of the nonperturbative effects discussed are strictly asymptotic ($\ln s > 16\pi\alpha'/g^2 \simeq$ 25) and only perturbation theory is relevant at ISR energies.

10276 (CONF-740713-, pp I.152-I.157) FINITE ENERGY SUM RULES: RECENT DEVELOPMENTS. Worden, R. P. (Rutherford Lab., Chilton, Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

FESR evaluations are currently increasing both in number and in accuracy. This progress has been made possible by the steady accumulation of experimental data leading to better low energy phase shift analysis. It is therefore now possible to look for general features in a large number of FESR's. The reactions considered with their recent phase shift analyses, the resulting FESR evaluations and the FESR cutoffs in terms of ½(s-u) are tabulated. Results pose the possibilities that either FESR's are somehow misleading or that FESR are correct but high energy amplitudes are complicated. (LBS)

10277 (CONF-740713-, pp I.158-I.167) FINITE MASS SUM RULES. Hoyer, P. (State Univ. of New York, Stony Brook). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Recent progress that has been made in applying duality to many-body ($\geq$3) final states is reviewed. These applications are closely analogous to the two-body ones, and can conveniently be divided into three main areas. (1) The use of Finite Mass Sum Rules (FMSR) to constrain high energy (triple-Regge) parameters. (2) Two-component duality, in particular for the case of Pomeron-particle scattering. (3) Semilocal duality in Reggeon-particle scattering. There is now substantial evidence for the expected dual features in (1) and (3). Both the theoretical and phenomenological evidence is rather controversial in (2). (UK)

10278 (CONF-740713-, pp I.172-I.176) EXTENDING 2-BODY HADRON REACTIONS TO LARGE ANGLES AND LOW ENERGIES. Kane, G. (Univ. of Michigan, Ann Arbor). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Recent results are presented showing how workable high energy, forward direction models might be extended to low energies and large angles. Discussing first intermediate t, it is shown that the Classical Absorption Model (CAM) (Hartley and Kane, Nucl. Phys.; B57: 157 (1973)), which has a simple form for each Reggeon exchange with no structure not required by general arguments and in which absorption effects are computed in the ordinary way, can be used to obtain successful results. At very large t it is shown that a large class of models can be included. It is concluded that: (1) In this approach all helicity amplitudes asymptotically have the same phase so polarizations vanish. (2) The large angle behavior of hadron 2-body cross sections may be as useful as electromagnetic form factors in learning about hadron structure. (3) Apparently leading Regge behavior plus unitarization (in the form of absorptive corrections) can produce observed phenomenological dual behavior as an output result. (4) It may be possible to have one model for all two body hadron reactions, at all s, t, with very simple large t behavior. (UK)

10279 (CONF-740713-, pp I.185-I.192) SOME ASPECTS OF TWO-BODY PHENOMENOLOGY. Field, R. D. (California Inst. of Tech., Pasadena). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Phenomenological concepts are discussed with respect to high energy strong interaction data presented to the XVII International Conference on High Energy Physics (London) 1974. In considering Regge behavior, a quick analysis of the $\pi^-p \to \pi^0n$ and $\pi^-p \to \eta n$ data at 100 GeV/c was made from which it is deduced that: the flip/non-flip ratio of the ρ exchange coupling has to be increased about 10% over the previous value, Regge shrinkage is shown, the large t points of the 100 GeV/c data do not shrink quite as fast as a pole of slope as fast as would be predicted, which might indicate small absorptive corrections, the η data decrease faster with energy than the π^0 data. Large t dips or wrong-signature-nonsense zeros (WSNZ) are considered. Two aspects of the Pomeron, two-component duality and s-channel helicity conservation are discussed. SU(3) sum rules calculated using new data are presented. Predictions of the quark model are tested using new data and it is shown that they are well satisfied. Experimental results now available indicate the necessity of non-factorizing absorptive (Regge cut) effects in inclusive processes. (UK)

10280 (CONF-740713-, pp I.193-I.227) PLENARY REPORT ON REACTION MECHANISMS AT HIGH ENERGY. Barger, V. (Univ. of Wisconsin, Madison). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Reaction mechanisms at high energy are considered with especial emphasis on the interpretation of interesting new data from IHEP, NAL and ISR. The review covers: Bounds from field theory (Froissart bound, MacDowell–Martin bound). Real parts of scattering amplitudes, analytic derivative relation. Proton-proton scattering (experimental, geometrical scaling, inelastic overlap function model, eikonal models (energy independent eikonal and factorizable eikonals, naive geometrical pomeron), experimental tests of models. Symmetry predictions for exchange couplings (total cross sections, production amplitudes). πN charge exchange reactions. Phenomenology of inelastic reactions (Regge pole exchange, Reggeized absorption approach, direct channel peripheral models, dip systematics for tensor exchanges). Double charge exchange reactions, Regge–Regge cuts. The crossover phenomena. Scattering at large angles, parton model. (UK)

10281 (CONF-740713-, pp I.229-I.242) PLENARY REPORT ON STRONG INTERACTION DYNAMICS. Halliday, I. G. (Imperial Coll. of Science and Tech., London). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A review is presented of high energy strong interaction dynamics covering: exclusive channels and the s-channel unitarity equation, the pomeron and its consistency, rising total cross sections, field theory Reggeisation, and nuclear collisions. An extensive bibliography is included. (UK)

10282 (CONF-740713-, pp I.251-I.253) THE BAG: A NEW EXTENDED MODEL OF THE HADRON. Johnson, K.; Thorn, C. B. (Massachusetts Inst. of Tech., Cambridge). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A new extended model of the hadrons is described which brings together many of the qualitative features of such different models as dual models, quark models, and parton models. The model, named the Bag model, pictures the hadron as a finite region of space occupied by fields. The fields can include quark fields and can be nearly free so they behave as partons in the parton model at least over distances and times short compared to the size of the bag. (UK)

10283 (CONF-740713-, pp I.260-I.264) RECENT WORK ON STRING MODELS. Mandelstam, S. (Univ. of California, Berkeley). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Recent work on string models is discussed with special reference to the interacting-string vertex, showing directly that it possesses the required Lorentz transformation properties. The conformal invariance of the amplitude follows. (UK)

10284 (CONF-740713-, pp I.269-I.280) PLENARY REPORT ON DUAL MODELS. Olive, D. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The development of the dual theory from Veneziano's four meson amplitude is discussed. The two formulations of the theory — the operator and the string approaches are considered. The contributions of a large number of workers in the field are considered and a comprehensive bibliography is included. (UK)

10285 (CONF-740713-, pp II.101-II.112) CURRENT AND CONSTITUENT QUARKS. Meshkov, S. (National Bureau of Standards, Washington, DC). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The connection between hadron spectroscopy and the algebra of currents is discussed in the light of recent published results. Primarily through the idea of a unitary transformation, that takes one from current to constituent quark states, advances have been made in the theory of weak and electromagnetic transitions of hadrons and, via the use of PCAC, the theory of pionic transitions as well. The ability of this approach to describe meson and baryon decays, radiative decays and even reaction amplitudes is discussed. It is considered that there is now a very successful theory of current induced transitions in agreement with the constituent quark model multiplets. (UK)

10286 (CONF-740713-, pp II.134-II.139) MODELS OF BOUND QUARKS. Mandula, J. E. (Massachusetts Inst. of Tech., Cambridge). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Recent progress made towards constructing relativistic theories of permanently bound quarks in a field theoretic context is discussed. The physical content and formal properties of the recently proposed "Bound Quark Model" are reviewed and it is contrasted with the "Bag Model" although their field commutators have not yet been computed. It is concluded that these theories are obviously unconventional, but they seem consistent with all the general principles of relativistic quantum mechanics. Their true tests will come only when they are sufficiently well analyzed to be critically confronted by experiment. The physics embodied in these models is very attractive. They describe interacting quarks which are bound into mesons. The mesons can scatter off and decay into one another, but not into quarks. (UK)

10287 (CONF-740713-, pp II.157-II.160) CURRENT STATUS OF CONSTITUENT QUARKS IN RESONANCE PHOTO AND ELECTROPRODUCTION. Close, F. E. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The reaction $\gamma N \rightarrow N^*$ is useful for testing symmetry schemes like SU(6) and quark models since the photon has spin 1, mixed I = 0, 1 and U = 0. To illustrate the current status of quark models and approaches based on the Melosh transformation the resonance D_{13} (1520) is considered. It is concluded that the priorities in fitting models to data in the resonance region seem to be as follows. First, do the general algebraic properties (e.g. 1–3) work? If the answer is no then no explicit model built within the algebraic framework will work. If the answer is yes then one should go further and try to constrain the dynamical properties (SHO potential etc.). Places where explicit models have some advantages might be in their ability to take some account of SU(6) breaking effects by relating various N^* within a super-multiplet. (UK)

10288 (CONF-740713-, pp II.160-II.161) $^3P_0$ MODEL. Moorhouse, R. G. (Univ. of Glasgow). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The $^3P_0$ model is a physical model of resonance decay by quark pair creation; the created pair is an SU(3) singlet state of zero angular momentum and positive parity, hence $^3P_0$; the other, "spectator" quarks do not change their SU(3) quantum numbers, spin, etc. The model has been developed and applied to photoproduction by Peterson (Daresbury preprint (1974) DL/P 201). Overall reasonable agreement was found with the photoproduction data, with the exception of the S_{11} (1535) which may be due to an inappropriate treatment of the kinematic barrier factors. Le Yaouanc et al. (Orsay preprint, LPTHE 73/11) treat the $^3P_0$ model in a completely dynamical fashion and apply the result to $\pi N \rightarrow N^* \rightarrow \pi\Delta$ and $\pi N \rightarrow N^* \rightarrow \rho N$. The method is to sandwich a $^3P_0$ quark pair creation operator, γ(Create), with one coupling constant γ which is the only adjustable parameter between explicit quark model wave functions for the baryons and the meson. It is concluded that: as in the naive quark model calculations with currents, all the intermultiplet signs ($\{70,1^-\}$; $\{56,2^+\}$ etc) are predicted, and superior to the "current" type quark model calculations the overall relative sign of $\pi N \rightarrow N^* \rightarrow \Delta\pi(\rightarrow N\pi\pi)$ and $\pi N \rightarrow N^* \rightarrow \rho N$ ($\rightarrow N\pi\pi$) is predicted. This is because Δ and ρ decay by the same pair creation mechanism, leading to a final state of the same particles. (UK)

10289 (CONF-740713-, pp II.171-II.199) PLENARY REPORT ON RESONANCE SPECTROSCOPY (THEORY). Rosner, J. L. (Univ. of Minnesota, Minnesota, Minneapolis). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The present position covering the theory of resonance spectroscopy is considered under the following headings: Constituent quarks; new developments in the spectrum ($\pi\pi$, $K\pi$ scattering, the A_1 crisis, baryon analysis), $SU(6)_W$, constituents' duality (baryons–the crucial 70, L = 2 and 56, L = 3 mesons), confinement of quarks, charm. Current quarks; transitions and sum rules, the need for mixed representations, the Melosh transformation, phenomenological applications (pionic decays, radiative decays, uses of vector dominance–symmetrization of vertices and vector meson emission), specific models (oscillator quark, l-broken $SU(6)_W$ and "$^3P_0$"), problems at $q^2 \neq 0$ and elsewhere. It is concluded that a general language for describing hadronic transitions has come into being in the last couple of years. It seems verified by experiment, it has some theoretical basis, and it confirms many of the popular ideas about the classification of resonances. (LBS)

10290 (CONF-740713-, pp III.81-III.83) ABNORMAL NUCLEAR STATES. Lee, T. D. (Columbia Univ., New York). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

It has been suggested (Lee and Wick, Phys. Rev.; D9: 2291 (1974). Lee, Columbia Univ. Preprint CO-2271-27) that if there exists a strongly interacting 0^+ meson, then when the nucleon density becomes sufficiently high over an extended volume, there exists the possibility of abnormal nucleon states, hitherto unobserved. A summary of the quasi-classical arguments that led to such a suggestion and a few comments on the theoretical basis in quantum field theory are given. (UK)

10291 (CONF-740713-, pp V.23-V.40) THEORETICAL MODELS FOR LARGE TRANSVERSE MOMENTUM PHENOMENA. Ellis, S. D. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A review is given of the various models which have been proposed as explanations of the observed behavior of events containing hadrons with large transverse momentum. The two major classes of specific models, fireball models and hard scattering (parton) models within the context of the single particle inclusive spectrum near $\theta_{c.m.} = 90°$ are considered. The possible ways in which more detailed information on correlations and particle composition may be understood and used to discriminate between various models is discussed. A short summary of some of the other possible explanations for large $p_\perp$ events and more novel forms of analysis which have been suggested is given. Major emphasis is on inclusive processes and in particular $pp \to \pi X$ but there is some discussion of models to large $p_\perp$ exclusive processes. (UK)

10292 HADRONS FROM LEPTONS? Faddeev, L.D. (V. A. Steklov Mathematics Institute). JETP Lett. 21: No. 2, 64-65 (20 Jan 1975).

The possibility is discussed of the appearance of strongly interacting particles as excitations of a system of weakly interacting fields. (auth)

10293 COLORED-QUARK VERSION OF SOME HADRONIC PUZZLES. Nussinov, S. (Department of Physics and Astronomy, Tel Aviv University, Tel Aviv, Israel). Phys. Rev. Lett. 34: No. 20, 1286-1289 (19 May 1975).

A simple picture based on colored quarks and gluons yields $\alpha_\rho(0) = 1/2$, $\alpha_A(0) = 0$, and $\alpha_\rho(0) = 1$, and explains various features of Pomeron exchange. (auth)

10294 MISSING MASS AS AN ALTERNATIVE TO RAPIDITY GAP IN THE EXPERIMENTAL STUDY OF DIFFRACTION AT HIGH ENERGY. Chew, D.M.; Shankar, R. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 11: No. 5, 1036-1039 (1 Mar 1975).

The study of Regge and multi-Regge processes can be carried out either in terms of the rapidity or the missing-mass variables. In theoretical studies it is more advantageous to use the rapidity variable, while in practice missing masses are easier to measure. The asymptotic relations between the two variables, known in theory, are not reliable at presently available energies. We derive here a formula that provides a statistical relation between the two variables, reliable even at present energies and demonstrate its validity by applying it to a sample of events in which both the missing-mass and the rapidity variables are known. (auth)

10295 ANALYSIS OF CORRELATION FUNCTIONS IN MULTIPERIPHERAL CLUSTER MODELS WITH SIMULTANEOUS EMISSION OF CLUSTERS OF DIFFERENT MULTIPLICITY. Makarowitz, L. (The City College of the City University of New York, New York, New York 10031); Shpiz, J.M. Phys. Rev. D 11: No. 5, 1048-1058 (1 Mar 1975).

Experimental results indicate that the "Mueller two-body correlation function" f_2^{ch} is positive at laboratory momentum above about 50 GeV/c. To obtain positive f_2, we examine multiperipheral models modified to include more than one different vertex type, with more than one particle emitted at some vertices. We will show that in such models, $f_2 = c_2 \ln(s) +$ constant at high energy, and c_2 can be positive. Furthermore, $\langle N \rangle$ and all correlation functions f_j also go as $c_j \ln(s)$ at high s. As a result, the model features a special form of Koba-Nielsen-Olsen (KNO) scaling. We have made a numerical analysis of the model for clusters of up to eight particles emitted at the vertices, and we calculate the average multiplicity, the Mueller two-body correlation function, and the Mueller three-body correlation function. We obtain a favorable, though crude, fit to the experimental data. (auth)

10296 SOME APPLICATIONS OF *f/P* UNIVERSALITY TO INCLUSIVE PROCESSES IN THE TRIPLE REGGE REGION. Balázs, L.A.P. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510. Phys. Rev. D 11: No. 5, 1071-1082 (1 Mar 1975).

The notion of *f/P* universality is shown to hold in a broad class of models even when an elementary version of the *f*-coupled Pomeron does not. It is then applied to triple-Regge vertices (*ijk*). At the same time we invoke exchange degeneracy, but only when $k \neq P$ (the case $k = P$ was recently shown to lead to inconsistencies, at least if applied exactly). Given the *f* and *P* Regge residues for a two-body process such as $pp \to pp$, we can then relate PPR, RRP, RRR, and *RPP* to *PPP* (where $R = f, \omega$) and $\pi\pi R$ to $\pi\pi P$, which can be calculated from the πp asymptotic cross section; the cross terms *RPR* and *PRR* drop out, but the *RPP* and *PRP* must be kept. This leaves only *PPP* to be actually fitted to the data. It serves mainly to fix the over-all scale of the cross sections at a given t. The shapes of the missing-mass distributions and the deviations from scaling are all predicted in our scheme. Within the rather large theoretical (input) uncertainties which are involved, the results are in reasonable agreement with both high-and low-missing-mass data (the latter via a finite-mass sum rule). Finally, if we combine our approach with factorization, we can predict the cross sections for processes such as $p\pi^- \to pX$ even in a region where nonscaling terms are important. (auth)

10297 TWO-POMERON CONTRIBUTION TO THE TOTAL CROSS SECTION. Moen, I.O. (Physics Department, McGill University, Montreal, Quebec, Canada); Zakrzewski, W.J. Phys. Rev. D 11: No. 5, 1175-1182 (1 Mar 1975).

The two ways (multiperipheral and t-channel unitarity) of calculating the contribution of two Pomerons are compared. It is argued that the t-channel calculation is more reliable; however, it is also argued that the t-channel calculation based on partial-wave unitarity may not give the whole story and a different approach is suggested. This approach leads to a completely new type of contribution, which for Reggeons with intercept less than 1 gives the dominant part asymptotically, but gives the same leading asymptotic behavior as the other "multiperipheral-like" part for intercept-1 Pomerons. As expected the two-Pomeron contribution to the total cross section is negative. (auth)

10298 REGGE SURFACES AND ELASTIC UNITARITY. Oehme, R. (Institut für Theoretische Kernphysik, Universität Karlsruhe, Karlsruhe, Germany). Phys. Rev. D 11: No. 5, 1191-1198 (1 Mar 1975).

General singular Regge surfaces $j = \alpha(t)$ of the continued partial-wave amplitude are considered in connection with the requirements of elastic t-channel unitarity. In the absence of shielding cuts, threshold branch points of the trajectory function $\alpha(t)$ can be used for ordinary and for complex Regge-pole surfaces in order to obtain compliance with the unitarity condition. For complex pole surfaces, there are important constraints concerning the way in which the threshold must appear in $\alpha(t)$. Branch-point surfaces are discussed in detail. It is shown that hard branch-point trajectories $\alpha(t)$ with t-independent character generally cannot be made compatible with elastic unitarity by using threshold branch points of $\alpha(t)$. Shielding cuts in the j plane are a natural requirement for these singular surfaces. The notions of "shielding cuts" and "hiding cuts" are defined briefly. (auth)

10299 TWO-BODY PHENOMENOLOGY AND INCLUSIVE CROSS SECTIONS IN THE TRIPLE-REGGE REGION. Kronenfeld, R.; Thews, R. (Department of Physics, University of Arizona, Tucson, Arizona 85721). Phys. Rev. D 11: No. 5, 1251-1261 (1 Mar 1975).

We propose that Mueller-Regge theory be tested in the triple-Regge region by taking ratios of inclusive cross sections which receive contributions from similar trajectories, so that normalized triple-Regge vertices are not needed. The remaining residues and trajectory functions are then determined using phenomenological fits to two-body differential cross sections. We consider three classes of fragmentations, involving baryon exchange, hypercharge exchange, and exotic exchange, respectively, and compare our predictions with available experimental data. Reasonable agreement with experiment is found in all cases. (auth)

10300 REAL PARTS OF FORWARD ELASTIC HADRONIC AMPLITUDES. Sidhu, D.P.; Sukhatme, U.P. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 11: No. 5, 1351-1353 (1 Mar 1975).

We compute the real parts of forward elastic hadronic scattering amplitudes using derivative analyticity relations and recent measurements of total cross sections at the Fermi National Accelerator Laboratory. The results on the ratios of real to imaginary parts, $\rho(s)$, for pp, $\bar{p}p$, π^+p, and K^+p are compared with the available experimental data. The agreement with the data is reasonably good. The real parts are predicted to change signs at energies $s \simeq 180$, 430, 120, 250, < 20, and 145 GeV^2 for $\bar{p}p$, pp, π^-p, π^+p, K^-p, and K^+p, respectively. (auth)

10301 CONSTRAINTS ON DISFAVORED FRAGMENTATION. Lo, S. (School of Physics, University of Melbourne, Parkville, Victoria, Australia 3052). Phys. Rev. D 11: No. 5, 1358-1361 (1 Mar 1975).

Further constraints are obtained for the behavior of the inclusive spectrum near the phase-space boundary. (auth)

10302 REGGEON CALCULUS AS A LOW-ORDER PERTURBATION THEORY FOR THE POMERON. DeTar, C. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 11: No. 4, 866-897 (15 Feb 1975).

We review the foundations of the Gribov Reggeon calculus with an emphasis on the relationship between the energy-plane and J-plane descriptions of the diagrams of the calculus. The question of the "large-rapidity-gap cutoff" for the Pomeron and the problem of signature are treated in more detail than in the traditional approach to the calculus. Except for some slight differences, the main results agree with Gribov's original formulation. We advocate the use of the Reggeon calculus as a refinement on the contemporary "two-component" model for the Pomeron and collect some formulas useful for phenomenological applications. (auth)

10303 EVIDENCE FOR CRITICAL SPACE-TIME DIMENSIONALITY OF 4 IN THE SYMMETRIC-GROUP MODEL. Frampton, P.H. (Department of Physics, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 11: No. 4, 953-955 (15 Feb 1975).

It is shown that the symmetric-group model contains negative probabilities for any space-time dimensionality satisfying $d \geq 5$. (auth)

10304 QUARK IMPRISONMENT AND VACUUM REPULSION. Parisi, G. (Department of Physics, Columbia University, New York, New York 10027). Phys. Rev. D 11: No. 4, 970-971 (15 Feb 1975).

We describe a classical field theory in which infinitely long-range forces are present. These forces do not stem from a direct interaction among particles. They have their origin in a rather peculiar phenomenon, which we call vacuum repulsion. (auth)

10305 ASYMPTOTIC DECAY WIDTH OF EXCITED HADRONIC CLUSTERS. Rudaz, S. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). Phys. Rev. D 11: No. 7, 1915-1918 (1 Apr 1975).

The principle of detailed balance is used to investigate the asymptotic behavior of the average decay width of hadronic clusters in the framework of models, such as the dual resonance and statistical bootstrap models, where quasi-two-body decays are dominant, resulting in linear cluster decay chains. An expression for the width is derived in the high-mass limit, and its implications are discussed. (auth)

10306 IMPACT-PARAMETER STRUCTURE OF TWO-COMPONENT ABSORPTIVE MODELS. Rabinovici, E. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 11: No. 7, 1969-1978 (1 Apr 1975).

The impact-parameter structure of several two-component multihadronic production models is studied in the framework of elastic initial-state absorption. Models in which both the diffractive and the nondiffractive mechanisms lead to increasing cross sections are used to exemplify the nonlinear nature of absorption. It is found that absorptive effects may result in a large range of impact-parameter structures. On the one hand, diffractive components barely distinguishable from nondiffractive components are encountered and, on the other hand, absorption may lead to a "splitting" of the Pomeron into peripheral diffractive processes and central nondiffractive processes. (auth)

10307 EXPERIMENTAL CONSEQUENCES OF THE EXISTENCE OF QUARKS. Mongan, T.R. (2237 17th Avenue, San Francisco, California 94116); Kaufman, L. Phys. Rev. D 11: No. 7, 1986-1992 (1 Apr 1975).

Reasonable assumptions about quarks and their interactions lead us to expect relatively copious production of these particles through diffraction disintegration of cosmic-ray protons into their constituent quarks. We estimate here the production threshold, cross section, fluxes, and momentum spectra of the quarks. (auth)

10308 ASYMPTOTICALLY SCALE-FREE THEORY OF LARGE-TRANSVERSE-MOMENTUM PROCESSES. Ezawa, Z.F.; Polkinghorne, J.C. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England). Phys. Rev. D 11: No. 7, 1993-1999 (1 Apr 1975).

It is shown that an ansatz for quark-quark interaction which is asymptotically scale-free has the property that it eliminates cumulative logarithmic modifications of hadronic wave functions and at the same time suppresses certain mechanisms for large-p_T processes which do not appear to be present phenomenologically. A further argument for such an asymptotically scale-free theory is presented, based on considering parton models which give large multiplicities in deep-inelastic current processes. (auth)

10309 HADRONIC PRODUCTION OF THE NEW RESONANCES: ARE GLUONS IMPORTANT?. Einhorn, M.B.; Ellis, S.D. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. Lett. 34: No. 18, 1190-1193 (5 May 1975).

In analogy with the Drell-Yan model for quark-antiquark annihilation into massive virtual photons, we study the possibility that the (presently) hypothetical pseudoscalar partner (η_c) of the new vector resonance (φ_c) observed at 3095 MeV is produced via gluon-gluon annihilation. This framework allows us to estimate cross sections for η_c production in hadronic reactions and also suggests to interesting possibility of employing η_c production as a probe of the distributions of gluons in hadrons. In addition, estimates are made for the production of pairs of charmed hadrons. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 10125 and 10670.

10310 (CONF-740713-, pp II.3-II.8) $\pi\pi$ AND Kπ SCATTERING: SPECIAL TOPICS (BASED ON EXTRACTS FROM "MINI-RAPPORTEUR" SUMMARY). Morgan, D. (Rutherford Lab., Chilton, Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Reviewing $\pi\pi$ and Kπ scattering data presented to the XVII International Conference on High Energy Physics (London) 1974 the area of threshold parameters in low energy $\pi\pi$ scattering is considered. The S-wave phase shift results show a consistent picture of δ_0^0 below 1 GeV but the new P-wave phase shifts do not resemble the results of fixed-t dispersion relations. The present position is discussed. It is shown that if one only measures the $\pi\pi$ elastic cross section, the elastic amplitude is only determined in magnitude, and its phase can (where information on σ_{tot} is lacking) in principle be arbitrarily changed. Suggestions for overcoming the difficulty are outlined. Other subjects mentioned include: inelastic channels, status of the S* (1000) effect, theory beyond the Roy equations (Morgan and Shaw. Phys. Rev.; D2: 520 (1970) and Basdevant et al. Physics Letters; 41B: 173 and 178 (1972)), and Kπ scattering. (44 references) (UK)

10311 (CONF-740713-, pp II.21-II.24) PROPERTIES OF OTHER MESONIC STATES. Chaloupka, V. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Data from 25 papers presented to the XVII International Conference on High Energy Physics (London) 1974 on meson resonances are tabulated. The particular particle, reaction, and momentum range are listed together with a brief comment to each entry. (UK)

10312 (CONF-740713-, pp II.139-II.140) RELATIVISTIC MODEL OF THE COMPOSITE PION. Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A model is presented in which mesons are treated as bound states of constituent fermions C and antifermions $\bar{C}$, (quarks, coloured quarks eg), using the Euclidean Bethe-Salpeter equation (B-S), with a kernel U(r,s) depending only on the relative coordinate $r = r_C - r_{\bar{C}}$ and on the mass of the bound state $\sqrt{s} = m_B$. Results obtained from the pion B-S equation using the potential (kernel) from the model are discussed. Certain approximations for the quark propagator, following quantum electrodynamic ideas, have been investigated. An unusual feature of the model which is mentioned is the presence of oscillating terms in the space-like assymptotic behavior of the pion form factor with a period of order 1 GeV. (UK)

10313 (CONF-740713-, pp II.141-II.143) MESON SPECTRUM, DECAYS AND FORM FACTORS FROM A DYNAMICAL QUARK MODEL. Bohm, M. (CERN, Geneva); Joos, H.; Krammer, M. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The dynamics of the meson spectrum, i.e., the relation between; the spectrum, the hadronic decay coupling constants, the leptonic decays and the electromagnetic form factors, are studied. Mesons are described as relativistic bound states of quark and antiquark. Confinement of quarks is achieved by the dynamical assumption that the quarks are heavy ($m_q^2 \gg 1$ GeV^2). (UK)

10314 (CONF-740713-, pp II.144-II.145) IS THE 0$^+$ NONET RESPECTABLE? Morgan, D. (Rutherford Lab., Chilton, Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A new scheme of assignments is proposed for the 0$^+$ nonet in which the S*(1000) effect is associated with resonance poles both on Sheet II and Sheet III, and with a single additional I = 0 resonance, ϵ, located somewhere above 1100 MeV. A tentative fit of these and the other nonet candidates, δ(970) and κ(~ 1200), is achieved. Overall width determinations for ϵ and S* to $\pi\pi$ agree quite well with predictions from higher symmetry schemes using versions of broken SU(6)$_W$. The two main ideas underlying the scheme are discussed. (UK)

10315 $N\bar{N} \to 3\pi$ AMPLITUDES AND THE SYMMETRIC-GROUP DUAL RESONANCE MODEL. Nandy, A.; Frampton, P.H.; Kalogeropoulos, T.E. (Department of Physics, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 11: No. 5, 1040-1042 (1 Mar 1975).

Annihilation processes $N\bar{N} \to 3\pi$ are compared to a suitably adapted symmetric-group dual resonance model for pion-pion elastic scattering in which the over-all normalization is the only free parameter. The fits are found to be rather unsuccessful, essentially because of the absence of odd daughter trajectories, and it is shown that there is no way of obtaining a better result from this model, even by the usual artifice of completely eliminating the ρ trajectory. (auth)

10316 THRESHOLD PROPERTIES OF VENEZIANO MODEL FOR $\pi\pi$, πK, AND KK SCATTERING. Wong, N.N. (Department of Physics, University of Malaya, Kuala Lumpur, Malaysia); Kamal, A.N. Phys. Rev. D 11: No. 7, 1896-1904 (1 Apr 1975).

The S and P partial waves are projected out at low energies for $\pi\pi$, πK, $K\bar{K}$, and KK scatterings from the Veneziano amplitude. The scattering lengths and the effective ranges are compared with the current-algebra predictions. Using $\pi\pi$ scattering as an example one can project out an arbitrary partial wave. (auth)

10317 IS ψ (3695) $\rightarrow \psi$ (3105) $\pi\pi$ A STRONG DECAY? Thacker, H.B. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794). Phys. Rev. D 11: No. 7, 2013-2015 (1 Apr 1975).

It is shown that radiative decay for bound states of higher-mass objects will be greatly suppressed owing to the orthogonality of bound-state wave functions. By assuming that the average magnitude of the wave vector of the radiative field (dipion) is small compared to the inverse Bohr radius, the suppression factor is determined and used to relate the decay rates $\Gamma(\psi \rightarrow \psi\pi\pi)$ and $\Gamma(\rho' \rightarrow \rho\pi\pi)$. For a ρ' width of 400 MeV, $\Gamma(\psi' \rightarrow \psi\pi\pi) \simeq 300$ keV is obtained. (auth)

10318 COMMENT ON A NARROW MESON RESONANCE AT 1932 MeV. Weingarten, D.; Okubo, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. Lett. 34: No. 18, 1201-1204 (5 May 1975).

A number of characteristics of a narrow resonance observed in $\bar{p}p$ scattering can be explained by assuming that it is a nucleon-antinucleon system, rather than quark-anti-quark. This object, together with similar states in other baryon-antibaryon channels, could be instrumental in the saturation of duality constraints. Relations between our proposal and models for ψ and ψ' are discussed. (auth)

10319 PURELY ALGEBRAIC APPROACH TO THE NEW NARROW RESONANCES. Takasugi, E.; Oneda, S. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. Lett. 34: No. 17, 1129-1131 (28 Apr 1975).

The narrow width of ψ (3105), as an uncharmed member of the 1^{--} meson multiplet of SU(4), is discussed in a purely algebraic manner without referring to quarks. A crucial test of this assignment of ψ (3105) is proposed. (auth)

10320 SIMPLE STRUCTURE OF CHARGED NEUTRAL CORRELATIONS. Grassberger, P.; Miettinen, H. I. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 89: No. 1, 109-117(14 Apr 1975).

All available high energy data agree with the assumption that the charged versus neutral pion multiplicities are described by a binomial distribution. This distribution is obtained in a variety of models. One of these is the Mueller model, supplied with the assumption of the absence of exotic contributions. In contrast to this, a binomial distribution cannot be obtained in any neutral cluster model. (auth)

10321 TWO MASS RELATIONS FOR MESONS FROM STRING-QUARK DUALITY. Brink, L. (Goeteborg Univ. (Sweden). Institutionen foer Teoretisk Fysik); Nielsen, H. B. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., B; 89: No. 1, 118-132(14 Apr 1975).

A self-consistency equation derived previously for the Nambu string is generalized to strings carrying SU(6) quantum numbers. The self-consistency equations are derived by considering the propagation of a string with the quantum numbers of the physical vacuum. Since the world sheet that the string sweeps out can be mapped onto rectangles, and the wave function of the physical vacuum is a constant, the boundary conditions are the same on all four sides of the rectangles. The propagator can then be calculated in two ways and this leads to the self-consistency equations. For the strings carrying SU(6) quantum numbers the propagator of strings with the quantum numbers of the physical vacuum is considered all along the string except for having quark quantum numbers either attached or removed from the ends. These self-consistency equations can be solved in a certain approximation and for this case they lead to mass formulas for mesons that are well satisfied in nature. (auth)

10322 PARTIAL WAVE ANALYSIS OF THE 3π STATES COHERENTLY PRODUCED ON NUCLEI. Bemporad, C.; Beusch, W.; Websdale, D. (European Organization for Nuclear Research, Geneva (Switzerland)); Freudenreich, K.; Muehlemann, P.; Pernegr, J.; Wetzel, W. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)); Bellini, G.; Di Corato, M.; Palombo, F. pp 131-132 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A preliminary spin-parity analysis of the $\pi^+\pi^-\pi^-$ system, produced coherently on nuclei, shows predominance of the 1^+ state, some admixture of 0^- and absence of the 1^-, 2^+ ... natural parity series. Some evidence is presented for the absorption of the 0^- final state in nuclear matter being substantially larger than that of the 1^+ state. (auth)

10323 DETERMINATION OF THE COUPLING CONSTANTS KNΛ AND KNΣ FROM DATA ON THE DIFFERENTIAL CROSS SECTIONS OF THE PROCESSES $\bar{p}p \rightarrow K^-K^+$, $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$ AND $\bar{p}p \rightarrow \bar{\Sigma}^+\Sigma^+$. Dubnicka, S.; Dumbrajs, O. V.; Staszel, M. (Joint Inst. for Nuclear Research, Dubna (USSR)). Nucl. Phys., B; 88: No. 3, 477-481(7 Apr 1975).

A determination of the coupling constants KNΛ and KNΣ from existing differential cross section data for the processes $\bar{p}p \rightarrow K^-K^+$, $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$ and $\bar{p}p \rightarrow \bar{\Sigma}^+\Sigma^+$ was carried out. The method is based on the extrapolation of $d\sigma/d\Omega$ to the hyperon and kaon poles respectively, exploiting conformal mapping techniques. Calculations result in values which favor SU(3) predictions. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 10142, 10406, and 10431.

10324 (CONF-740713-, pp I.76-I.79) PARTICLE CORRELATIONS. Ko, W. (Univ. of California, Davis). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVI international conference on high energy physics.

A summary is given of work carried out on particle correlations at high energies. The normalized correlation function $R(y_1y_2)$ is defined. Many groups have studied the rate of drop of $R(y_1y_2)$ as the separation between the two particles increases and found that it shows distinct features which are discussed. Semi-inclusive correlations of like and unlike charged pions and the semi-inclusive charge-charge correlations at ISR are considered. Local compensation of charges can be measured by the distribution of the rapidity interval in which the sum of the charges is 0 or by charge transfer fluctuation. Considering production correlations it is stated that there is a great deal of new data on the value of $\langle n_\pi o \rangle$ as a function of the number of π^-'s produced. (UK)

10325 (CONF-740713-, pp I.180-I.185) PRODUCTION MECHANISMS FOR VECTOR AND TENSOR MESONS. Michael, C. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Vector (PN $\rightarrow$ VN) and tensor (PN $\rightarrow$ TN) meson production data allow refinement of investigations of exchange mechanisms. The charge exchange production of vector mesons can be understood in terms of meson exchange contributions. The π exchange component is well controlled and extrapolations to on-shell π scattering can be made with some confidence. Further data should allow a better study of the less dominant contributions; higher energy $\pi N \rightarrow \omega N$ data and polarized target information in $\pi^-p \rightarrow \rho^0 n$ are particularly appropriate data. The photoproduction and tensor meson production data show a tantalizing systematic trend in that the cut contributions are progressively weaker for heavier produced states. Dual resonance model expectations for the production of higher Regge recurrences are shown to be very useful. (UK)

10326 (CONF-740713-, pp II.8-II.12) RESULTS ON $\pi^+p \rightarrow \pi^+\pi^+\pi^-p$. Ascoli, G. (Univ. of Illinois, Urbana). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

New results obtained on the reaction $\pi^+p \rightarrow \pi^+\pi^+\pi^-p$ by various groups are outlined and comments made on possible interpretations. All groups agree that the A_1 bump occurs exclusively in $1^{+S} \rightarrow p\pi$ and that the phase of the A_1 (relative to other waves showing no enhancement in the A_1 region) has little or no dependence on $m_{3\pi}$, thus excluding any simple resonance interpretation. However the new π^+p results have confused rather than clarified the status of the A_3. Reasons for the inconsistencies are discussed. The cross section for A_1^- and A_2^- production in $\pi^-p \rightarrow \pi^-\pi^+\pi^-p$ has been measured from $p_{LAB} = 5$ to 40 GeV. For A_2^- the energy dependence has been observed also in the decay modes $A_2^- \rightarrow \eta^0\pi^-$ and $A_2^- \rightarrow K^0K^-$. The conclusion is that the energy dependence of A_1^- and A_2^- are essentially the same. The Regge model of A_2 production is considered. (UK)

10327 (CONF-740713-, pp II.51-II.54) $\pi\pi N$ PARTIAL WAVE ANALYSIS. Neveu, M. (CEN, Saclay, France). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Results of $\pi\pi N$ energy independent partial wave analysis presented to the XVII International Conference on High Energy Physics by various groups (LBL-SLAC, Saclay, and Imperial College-

Westfield College–Cambridge) are discussed and compared. The analyses cover the energy range of 1.3 to 2.0 GeV in the center of mass system. The extended isobar model which is the essential tool of $\pi\pi N$ partial wave analyses is discussed. The three analyses show a similar behavior for the $\Delta\pi$ amplitudes and the signs of these amplitudes are in excellent agreement. The dipion production position is considered and it is shown that it is not well defined. (UK)

10328 (CONF-740713-, pp II.54-II.60) KN SCATTERING. Cutkosky, R. E. (Carnegie-Mellon Univ., Pittsburgh). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The content of papers presented to the XVII International Conference on High Energy Physics (London) 1974 presenting analyses of K^+p data are shown in tabular form. Summarizing the following points are emphasized: (1) The K^+p data can be well understood in terms of particle exchanges. (2) As yet there is no clear evidence for either a Z_1^+ or a Z_0^+ but long range forces suggest that a Z_1^+ is the most likely. A Z_1^+ produced by long range forces would be broad, probably quite inelastic, and not necessarily require a quark model interpretation. (3) Data on spin rotation in K^-p scattering is needed for an experimental test of the various reported fits, and in any case to reduce uncertainties. (4) Much new data pertaining to I = 0 is needed, especially at higher energies (up to 2 GeV at least). More polarization data is urgently required. (5) If the elastic amplitudes should continue to suggest a resonant-like behavior, an attempt should be made to verify the existence of a resonance pole through study of the Z^* in production as well as formation experiments, including a study of its inelastic decay modes. (UK)

10329 (CONF-740713-, pp II.61-II.64) ISOBAR MODEL ANALYSES OF STRANGENESS-1 BARYONS. Kenyon, I. (Univ. of Birmingham, Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Isobar model analyses applied to data obtained from K^-d Bubble Chamber experiments with beam moments 1.18, 1.33, 1.45, 1.65 and 1.78 GeV/c are described. Results from 536 examples of $\Lambda(1520) \rightarrow \Lambda\pi^+\pi^-$ Dalitz Plot analysis are tabulated. The SU(3) singlet-octet mixing angle θ was calculated. The analysis showed the considerable sensitivity in the determination of θ to the choice of barrier factor due to the closeness of the Σ (1385) to the edge of the allowed kinematic region and also to the form of the $\pi\pi$ s-wave phase shift. Analysis of the reactions $K^-n \rightarrow K^-\pi^-p$ and $K^-n \rightarrow \bar{K}^0\pi^-n$ in the center-of-mass energy range 1.9 to 2.2 GeV showed the variation with energy of the cross sections for various partial waves. In particular the $1/2^+$ Λ (1815) π amplitude shows clear resonant structure around 2050 MeV. From the variation of these cross sections with center-of-mass energy it has been possible to obtain the following estimates of the Σ (2030) branching fractions: $\Lambda(1815)\pi$, 0.14 ± .04. $\Delta\bar{K}$, < 0.15. $K^-{}^*N$ < 0.17. $\Lambda(1520)\pi$ < 0.03. (UK)

10330 (CONF-740713-, pp II.65-II.100) PLENARY REPORT ON BARYON RESONANCES. Litchfield, P. J. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A review of papers covering work on baryon resonances, contributed to the XVII International Conference on High Energy Physics (London) 1974, is presented. New results on the strangeness +1 (KN), strangeness 0 (πN) and strangeness –1 ($\bar{K}$N) reactions are discussed. A survey of the present resonance candidates is presented with a view to extracting a set of resonances that can be used to test classification schemes and models with some degree of reliability. Finally an attempt is made to assign these baryon states to their SU(6) × O(3) supermultiplets. (39 references) (UK)

10331 (CONF-740713-, pp II.113-II.120) PARTIAL-WAVE ANALYSIS OF $\pi N \rightarrow N\pi\pi$ (AS $\Delta\pi$ + rhoN + epsilonN) UP TO $\sqrt{s}$ = 2000 MeV. Herndon, D. J. (Lawrence Berkeley Lab., CA); Longacre, R.; Miller, L. R.; Smadja, G.; Soding, P.; Cashmore, R. J.; Leith, D. W. G. S. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The partial wave analyses of the reaction $\pi N \rightarrow N\pi\pi$ at energies between $\sqrt{s}$ = 1300 and 2000 MeV is reported. Resonance parameters have been extracted from Argand plots obtained from events in three different ways. Large amplitudes agree to ± 15% (partial widths to ± 30%) but smaller resonance parameters disagree badly. The Argand plots yield the signs of 17 couplings for $N^* \rightarrow \Delta\pi$, which agree very well with the predictions of ϵ-broken $SU(6)_W$ and the quark model. Twelve ρN signs are also found and two of them are in disagreement with the signs predicted from $\Delta\pi$ fits. (UK)

10332 (JINR-P1-8665) RELATIVISTIC GENERALIZATION OF STATISTICAL MODEL FOR SEMI-INCLUSIVE PROCESSES WITH STRANGE PARTICLES. Glagolev, V. V.; Dushutin, N. K.; Kuznetsov, A. A.; Maltsev, V. M.; Pestova, G. D.; Sabeu, M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The results of comparison of the relativistically generalized statistical model with experiment are presented. The generalization assumes that the function of energy and temperature, which enters into the canonical distribution exponent, is replaced by the product of 4 vectors $\tilde{P}\,\tilde{\alpha}$ where $\tilde{P}$ is a four-momentum and $\tilde{\alpha}$ is a vector characterizing the irradiating subsystem. The comparison is made with the experimental data obtained in an exposure of the JINR 100-cm hydrogen bubble chamber to π^--mesons of 5 GeV/c. Reactions of the type $\pi^-p \rightarrow \Lambda$ + everything are analyzed. The interaction picture in which the statistical subsystem is moving as the whole, suggested by the model, does not contradict the experimental data. (auth)

10333 (WIS-Ph-73/37) CLASSIFYING BARYONS. Faiman, D. (Weizmann Inst. of Science, Rehovoth (Israel)). [nd]. 11p. INIS.

Invited talk given at the second Aix-en-Provence International Conference on elementary particles, Sept. 1973.

At the present stage of its development the Melosh transformation as applied to baryon spectroscopy goes a considerable way towards providing a theoretical foundation for some already successful quark model and symmetry ideas. (auth)

10334 DETERMINATION OF THE Δ^{++}-Δ^0 MASS DIFFERENCE. Ball, J.S.; Goble, R.L. (Department of Physics, University of Utah, Salt Lake City, Utah 84112). Phys. Rev. D 11: No. 5, 1171-1174 (1 Mar 1975).

The 3-3 phase shift obtained from π^+p and π^-p scattering is used to determine the positions of the poles in the S matrix corresponding to the Δ^{++} and Δ^0. The mass difference is then given by the separation of these poles. (auth)

10335 DOES THE POMERON HAVE VACUUM QUANTUM NUMBERS?. Pumplin, J. (Department of Physics, Michigan State University, East Lansing, Michigan 48824); Kane, G.L. Phys. Rev. D 11: No. 5, 1183-1190 (1 Mar 1975).

From general arguments, the imaginary part of every elastic scattering amplitude at sufficiently large impact parameter is governed by the two-*pion* exchange cut in the t channel. Consequently, the large-impact-parameter tail of the Pomeron is not an SU(3) singlet. We calculate the contribution of the tail (typically about 1/4 of σ_T) approximately, and thereby predict observable differences between high-energy total cross sections for πp and Kp, and between pp, Λp, Σp, and ΞP. We estimate the asymptotic difference between πp and pp cross sections. We also obtain nonzero estimates for the diffractive helicity-flip component of elastic scattering, and for diffractive contributions to processes such as $\pi p \rightarrow A_2 p$ and $Kp \rightarrow K^*(890)\,p$. We predict cross sections for A_2 and K^* at Fermilab, and elastic polarizations, e.g., in $pp \rightarrow pp$ and $\Lambda p \rightarrow \Lambda p$, at asymptotic energies. (auth)

10336 ρNN AND $\rho N\Delta$ COUPLINGS FROM REGGEON DUALITY. Hoyer, P. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. D 11: No. 5, 1220-1233 (1 Mar 1975).

We show how the cancellation between the nucleon and Δ (1232) contributions to finite-energy sum rules for $\pi N \rightarrow \pi N$ amplitudes can be used to determine the πNN and $\pi N\Delta$ coupling constants. We then apply the same method to finite-energy sum rules for the $\rho N \rightarrow \pi N$ and $\rho N \rightarrow \rho N$ Reggeon amplitudes. A unique solution is found, for which the ρNN helicity nonflip coupling vanishes and the $\rho N\Delta$ coupling is of the $M1$ type. The relative size of the ρNN helicity flip and $\rho N\Delta$ $M1$ couplings is also in agreement with experiment. (auth)

10337 RESONANT PARTIAL-WAVE AMPLITUDES IN $\pi N \rightarrow \pi\pi N$ ACCORDING TO THE NAIVE QUARK-PAIR-CREATION MODEL. Le Yaouanc, A.; Oliver, L.; Péne, O.; Raynal, J. (Laboratoire de Physique Théorique et Hautes Energies, Université de Paris Sud, Bâtiment 211, 91405 Orsay, France). Phys. Rev. D 11: No. 5, 1272-1286 (1 Mar 1975).

We make an extensive comparison of the naive quark-pair creation model of strong-interaction vertices for $\pi N \rightarrow N\pm \rightarrow \Delta\pi$, ρN, $\sigma N \rightarrow \pi\pi N$ with recent experimental results. The model describes any vertex in terms of a quark-pair creation in the $^3P_0$ state and a rearrangement leading to final states. The hadron states are given by SU(6)-harmonic-oscillator wave functions. We show that the model correctly describes, without any additional assumption, the centrifugal barrier effect and also the "anti-SU(6)$_w$" coupling signs, features that are present in most

reactions (with the important exception of $FP_{15} \rightarrow \Delta\pi$ for the second feature) and are included phenomenologically in the works of Rosner *et al.* Both facts are related to the presence, in the limit of elementary meson emission, of recoil terms depending on internal quark momenta. Contrary to other works, the model predicts the relative coupling signs for all the two-body baryonic decays leading to $\pi\pi N$. Concerning $\Delta\pi$ and ρN channels, among 18 predictions, 15 agree with experiment, comparing our results to the last report of the Particle Data Group, and three disagree. One of these three is the very serious failure $FP_{15} \rightarrow \Delta\pi$, which is among the best determined experimental coupling signs. We compare our predictions with parallel works. Unlike the model of Feynman, Kislinger, and Ravndal, in the limit of elementary ρ emission, our model presents a recoil term in the spin part of the interaction, $\vec{\sigma}\ (i) \cdot [(\vec{k}_{\rho} - \vec{k}\ i) \times \vec{\epsilon}_{\rho}]$. Thus, for $FP_{35} \rightarrow N\rho_3$, our model predicts an "anti-SU(6)$_w$" sign, in agreement with experiment and contrary to the prediction of Moorhouse and Parsons. For the controversial σ production, the model is contradicted by experiment; we show, however, that the model could be compatible with experiment if the $I = 0$, $J^P = 0^+$ dipion observed is not really a resonance. (auth)

10338 AMPLITUDES FOR $\pi^- p \rightarrow K^0\Lambda^0$ AND $\pi^- p \rightarrow K^0\Sigma^0$ AT 5 GeV/c. Ward, C.E.W.; Meyer, W.T.; Rust, D.R. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 11: No. 7, 1802-1805 (1 Apr 1975).

Using our data on $d\sigma/dt$ and polarization in $\pi^- p \rightarrow K^0\Lambda^0$ and $\pi^- p \rightarrow K^0\Sigma^0$ at 5 GeV/c, and assuming SU(3) octet dominance of the baryon couplings in s-channel helicity amplitudes, we determine amplitudes for these reactions up to an undetermined over-all phase. We calculate the spin rotation parameters $\hat{A}$ and $\hat{R}$ and compare our predictions with those from phenomenological models. Assuming a Regge phase for the helicity-flip amplitude, we find that the imaginary part of the nonflip amplitude for these reactions shows peripheral behavior but the real part does not. (auth)

10339 RESONANCE SPINS AND THE t DEPENDENCE OF REGGE RESIDUES IN MULTIPERIPHERAL MODELS. Dash, J.W. (Argonne National Laboratory, Argonne, Illinois 60439); Jones, S.T. Phys. Rev. D 11: No. 7, 1817-1826 (1 Apr 1975).

We argue that the roughly exponential t dependence of Regge residues for small t can be understood within the context of multiperipheral cluster models if the clusters are identified with the resonance spectrum and the correct spin structure is included for the resonances. The difference between the slopes of the pp and πp differential cross sections is ascribed to the average shift of resonance spin by 1/2 between the baryon and meson resonances. An illustrative calculation is performed which leads to qualitative agreement with experiment. (auth)

10340 NEW SYSTEMATICS IN HADRON TOTAL CROSS SECTION. Lipkin, H.J. (Argonne National Laboratory, Argonne, Illinois 60439. Phys. Rev. D 11: No. 7, 1827-1831 (1 Apr 1975).

Analysis of total cross section data from 2 to 200 GeV/c shows striking regularities in the discrepancies between the experimental data and predictions based on two-component duality with exact exchange degeneracy, universality, and SU(3) symmetry. These regularities suggest that the discrepancies are not due to a number of unrelated breaking effects, but are all related and described by a single universal third component which has even-signature isoscalar exchange in the t channel, has exactly the same energy dependence for kaon-nucleon, pion-nucleon, and nucleon-nucleon scattering processes, and scales in the ratio 1 : 2: 9/2. This new component suggests a common origin for the strangeness dependence of the total cross sections and the deviations from quark-model additivity, and gives a unified description of the following apparently unrelated effects: (1) the $\sigma\ (\pi N) - \sigma\ (KN)$ difference, (2) the deviation of $\sigma\ (\pi N)/\sigma\ (NN)$ from 2/3, (3) differences in energy behavior of cross sections, particularly the decrease in $\sigma\ (pp)$ at low energies, and (4) the differences between $\sigma\ (K^+p)$, $\sigma\ (pp)$, and $\sigma\ (\phi p)$ which are all pure Pomeron in two-component duality. (auth)

10341 DETERMINATION OF (j, l) FOR Δ (2200) FROM A DUAL ANALYSIS OF BACKWARD $\pi^+ p$ SCATTERING. Ma, E. (Physics Department, University of California, Santa Barbara, California 93106); Shaw, G.L. Phys. Rev. D 11: No. 7, 1832-1836 (1 Apr 1975).

A negative-parity Δ resonance with mass roughly equal to 2200 MeV was recently discovered from careful measurements by Baker *et al.* of $\pi^+ p$ 180° elastic scattering. Combining the 180° data with angular distribution measurements near 2200 MeV, we investigate possible (j, l) assignments of the Δ (2200). We find: (1) There is little evidence for the existence of a G_{39}, ruling against a (56, L odd) quark model multiplet. The dominant contribution is D_{35}, which can be considered as the second member of a Regge Δ_β family, of which the $S_{31}(1650)$ is the first. (2) There are two distinct groups of resonances: one of negative parity at about 2200 MeV and the other of positive parity at about 2100 MeV. (3) While analysis of the 180° data alone cannot distinguish between a pure resonance fit or one using the dual interference model, only the interference model gives a good fit to all the data. (auth)

10342 SPIN EFFECTS IN HADRON SCATTERING AT VERY HIGH ENERGIES. Bourrely, C.; Soffer, J. (Centre National de la Recherche Scientifique, 13 – Marseille (France). Centre de Physique Theorique); Wray, D. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 89: No. 1, 32-44(14 Apr 1975).

A spin-dependent diffractive model is studied for πN and NN elastic scattering. Nontrivial results are found for spin correlation parameters which persist at high energies and have very distinct features in the dip region. It is stressed that these parameters provide good tests of pomeron factorization. (auth)

10343 ERICSON FLUCTUATIONS IN HIGH-ENERGY HADRON PHYSICS. Carlson, P. J. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 55-61 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Fluctuation phenomena are well known in many branches of physics. In particular, nuclear reactions and scattering cross sections show a randomness when the energy levels in the compound nucleus overlap. It was suggested that these Ericson fluctuations may also be present in particle physics. Evidence is presented for Ericson fluctuations in large angle πp elastic scattering at an incident laboratory momentum of 5 GeV/c. The fluctuations are found to be larger in π^+p than in π^-p. A quantitative evaluation of the fluctuating differential cross section as a function of energy for 0 and 180° πp elastic scattering is shown to be consistent with the observations in large angle scattering at 5 GeV/c, and is taken as support for an exponentially increasing density of hadron states. (auth)

10344 A PARTIAL WAVE ANALYSIS OF $\pi N \rightarrow \pi\pi N$ AT CENTER-OF-MASS ENERGIES BELOW 2000 MeV. Rosenfeld, A. H.; Herndon, D. J.; Longacre, R.; Miller, L. R.; Smadja, G.; Soeding, P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Cashmore, R. J.; Leith, D. W. G. S. (Stanford Linear Accelerator Center, Calif. (USA)); Gopal, G. P.; Stevens, R. A. (Imperial Coll. of Science and Technology, London (UK)). Phys. Lett., B; 55: No. 5, 486-490(17 Mar 1975).

The results of a partial wave analysis of $\pi N \rightarrow \pi\pi N$ in the energy region 1300 to 2000 MeV are presented. Two continuous solutions were found, in which all the major resonances are observed in the inelastic channels. The existence of P_{13} (1700) and P_{11} (1700) states are confirmed, and evidence for a new resonance, D_{13} (1700), is presented. Further, the best solution indicates the presence of resonant structure in the 1700 to 1900 MeV region for the P_{33} wave. Finally, analysis of data on $\pi^+ p \rightarrow \pi^+ p\pi^0$ at 1610 MeV demonstrates that this solution is the best description of inelastic πN scattering at these energies. (auth)

10345 APPLICATION OF MODULUS-PHASE DISPERSION RELATIONS TO πN BACKWARD SCATTERING. Sanchez-Gomez, J. L.; Paramio, L. (Universidad Autonoma de Madrid (Spain)). Nucl. Phys., B; 88: No. 3, 442-450(7 Apr 1975).

Modulus-phase dispersion relations are derived for the πN backward scattering amplitudes. The convenience of these dispersion relations in treating πN backward scattering is pointed out. A numerical evaluation of the π^-p backward scattering phase is also given. (auth)

10346 COLLISION BROADENING IN PARTICLE PHYSICS. Bugg, D. V. (Queen Mary Coll., London (UK)). Nucl. Phys., B; 88: No. 3, 381-410(7 Apr 1975).

The lifetime of a particle resonance, such as an N*, propagating through a nucleus or in the vicinity of a "spectator" nucleon is reduced by collisions, and consequently the width of the resonance is increased. This phenomenon is the nuclear analog of collision broadening, well known in atomic spectroscopy. It explains quantitatively the discrepancy between the πd total cross section in the resonance region and Glauber theory, a discrepancy previously ascribed to variation with energy of the parameter $\langle r^{-2} \rangle$. A simple rule is given for the energy of πd resonances relative to πN. The same arguments applied to Kd total cross sections indicate that the $\bar{K}N$ branching ratios of Y* resonances should be systematically increased over previously quoted results. It is shown how the channel $\pi d \rightarrow NN$ is related to Glauber theory, and an anomalous result obtained by Beder for the πd scattering length is explained away. A general rule is proposed for the shape of the N* (1230) in a nucleus of atomic number A, namely that the product of the width and the height of the resonance should be A times that for free πN collisions. In production reactions, absorption in the final state makes the resonance width increase with the momentum transfer, $-t$, at which the resonance is produced; the reaction $\pi^- p \rightarrow \rho^0 n$ is treated quantitatively as an example. The broadening of ρ mesons photoproduced in nuclei is also mentioned. Large collision broadening offers an explanation of the observation that the total cross section

of A_1 mesons in nuclei is close to that of pions and offers fresh insight into the phenomenon of diffraction dissociation. Two modifications to Glauber theory are given for the lifetime of a resonance in the final or intermediate state. It is shown that the usual ad hoc procedure of folding Fermi motion into the amplitude is exactly equivalent to including the propagator of the resonance. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 10037, 10450, and 10590.

10347 (CONF-740713-, pp I.80-I.83) PHENOMENOLOGY OF DIFFRACTION. Roy, D. P. (Rutherford Lab., Chilton, Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The two-component model provides a simple description of multiparticle production. The amplitude is considered to be the sum of the non-diffractive (ND) and diffractive amplitudes so that if interference between the two is neglected then the cross section can be simply expressed as $\sigma_{ND} + \sigma_D$. Knowledge of the diffractive component has been obtained by studying the reaction $pp \to pX$ in the small M^2/s (large x) region where σ_D dominates. A triple Regge expression is given which shows that the diffractive cross section is expected to peak near $x \simeq 1$ while the non-diffractive part will slowly fall. NAL and ISR data have confirmed the presence of the diffractive peak and give a precise estimate of the Pomeron-proton cross section. New properties for the diffractive component are given. The importance of the scaling contribution to the diffractive component is discussed. Several analyses of the data on $pp \to pX$ have been carried out and one is discussed here. Since there is substantial data on $pp \to pX$ more than one cross check can be carried out for each essential feature, i.e., s dependence, t dependence, M^2 dependence. (UK)

10348 (CONF-740713-, pp V.21-V.22) MULTIPLICITY RISE ASSOCIATED WITH TRANSVERSE MOMENTUM OF A PROTON IN pp AT 28.5 GeV/c. 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The sharp rise in the mean multiplicity associated with a fast forward proton in the reaction $P_1 + P_2 \to P_3 + MM$ which has been observed (Ramanauskas et al. Phys. Rev. Lett.; 31: 1371 (1973) and Anderson et al. XVII Int. Conf. High Energy Phys. London (1974) Paper 375) is discussed in the light of various models. It is shown that the data are consistent with the parton interchange model of Blankenbecker et al. (Phys. Lett.; 42B: 461 (1972)) which has two diagrams giving rise to inclusive hadron production and of the extension of this model suggested by Choudbury (XVII Int. Conf. High Energy Phys. London. (1974) Paper 482) but not with a double fragmentation model. (UK)

10349 (JINR-E4-8473) QUARTET S WAVE PHASE SHIFTS IN THE ND SCATTERING ABOVE THE DEUTERON BREAK-UP THRESHOLD IN THE APPROXIMATION LINEAR IN THE NN INTERACTION RANGE. Efimov, V. N.; Tkachenko, E. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

The quartet S-wave phase shifts are calculated for the nd-scattering above the deuteron break-up threshold. In the calculations the approximation linear in the NN-interaction range has been used. This approximation neglects the two-body t-matrix dependence on the NN-potential form. The calculation results fit well the experimental data. (1 figure) (auth)

10350 QUANTUM-NUMBER FLOW IN MULTIPARTICLE PRODUCTION. Murai, N. (Department of Physics, McGill University, Montreal, Canada H3C 3G1); Sasaki, T. Phys. Rev. D 11: No. 5, 1083-1093 (1 Mar 1975).

Conservation of quantum numbers at each vertex (or local conservation of quantum numbers) associates the rapidity dependence of inclusive spectra with the approach to the scaling limit in the central region within the framework of the multiperipheral model (MPM). A model incorporating various internal quantum numbers is developed by introducing quantum-number-flow states. We restore the properties (1) strong ordering of particles in rapidity and (2) threshold effect (production of a heavy pair requires a high threshold) of the MPM. Clustering in final states leads to a stronger energy dependence of the inclusive spectra as compared to a model where secondaries are produced directly. In pp collisions, the right order of magnitude of the rates of increase with energy among the π, K, and $\bar{p}$ inclusive spectra in the central region is reproduced in the incident-momentum region from 24 to 1000 GeV/c. (auth)

10351 ARE CONSTANT ASYMPTOTIC TOTAL CROSS SECTIONS RULED OUT BY HIGH-ENERGY MEASUREMENTS?. Sidhu, D.P. (Brookhaven National Laboratory, Upton, New York 11973); Wang, L. Phys. Rev. D 11: No. 5, 1354–1357 (1 Mar 1975).

It is a common belief that the conventional contributions of the Pomeron and the two-Pomeron cut in the Gribov Reggeon calculus cannot give enough rise of the pp total cross section at CERN ISR energies. However, we find from a detailed analysis of $d\sigma/dt$ at small t that one can, in fact, get a reasonable rise of the pp total cross section at CERN ISR energies. The K^+p total cross sections are also fitted. However, its consistency with $d\sigma/dt$ has to be checked out when the data are available. (auth)

10352 BETHE-SALPETER EQUATION FOR NUCLEON-NUCLEON SCATTERING: MATRIX PADÉ APPROXIMANTS. II. Gammel, J.L.; Menzel, M.T. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. D 11: No. 4, 963-966 (15 Feb 1975).

The matrix Padé approximants introduced in a previous paper are extended to include "off-shell" effects. The [1/1] Padé approximant becomes very accurate with the addition of only a few "off-shell" states. (auth)

10353 INCLUSIVE PRODUCTION ON NUCLEI AT LARGE TRANSVERSE MOMENTUM. Pumplin, J.; Yen, E. (Department of Physics, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. D 11: No. 7, 1812-1816 (1 Apr 1975).

We show that inclusive production data on nuclear targets at large transverse momentum can be interpreted according to the general features of the parton model. The data are inconsistent with "cascade" models, in which produced particles are assumed to interact independently with the nucleons in the nucleus. We propose an interpretation of the $A^{1.1}$–$A^{1.3}$ behavior which has been observed at $s = 560$ GeV^2. (auth)

10354 PROTON-PROTON SCATTERING, THE CHOU-YANG MODEL, AND PROTON FORM FACTORS. Franco, V. (Physics Department, Brooklyn College of the City University of New York, Brooklyn, New York, 11210). Phys. Rev. D 11: No. 7, 1837-1840 (1 Apr 1975).

Recent high-energy proton-proton elastic scattering angular distribution data for $0 < -t \leq 5.3$ (GeV/c)^2 are used with the Chou-Yang model to investigate the proton electromagnetic form factors. Comparisons with the measurements of the form factors are given. The use of the proton-proton data in the analysis reveals either the need for measurements at larger momentum transfers or possible inconsistencies when the model is applied at finite energies. Analytical fits to the angular distribution data are also presented. (auth)

10355 NUCLEON DIFFRACTIVE DISSOCIATION. I. PERIPHERAL MODEL WITH ABSORPTION. Tsarev, V.A. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 11: No. 7, 1864-1874 (1 Apr 1975).

A model for diffractive dissociation of hadrons into low-mass states is proposed. It is based on a peripheral mechanism with absorption. The absorption effects lead to an important modification of the amplitude by introducing an extra dependence upon momentum transfer and strong slope-mass correlation. A diffractive minimum is predicted for small values of the mass of the produced system. The connection with the crossover effects in diffractive dissociation is discussed. The nucleon dissociation is considered in detail. (auth)

10356 NUCLEON DIFFRACTIVE DISSOCIATION. II. ENERGY DEPENDENCE OF THE LOW-MISSING-MASS CROSS SECTION AND CONSTRAINTS ON TRIPLE-REGGE COUPLINGS. Tsarev, V.A. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 11: No. 7, 1875-1883 (1 Apr 1975).

The energy dependence of the Deck-type model is discussed and shown to be in good agreement with data on the low-mass nucleon diffractive dissociation. On the basis of finite-mass sum rules, relations between triple-Regge couplings and different Regge contributions to elastic and Deck amplitudes are obtained and duality for Reggeon-nucleon scattering amplitudes is examined. The normal two-component duality usually assumed for nondiffractive terms is found to be in contradiction with experimental data. (auth)

10357 RELATIVISTIC GREEN'S-FUNCTION APPROXIMATION TO THE LOW-ENERGY NUCLEON-NUCLEON INTERACTION. Mery, P.; Turchetti, G. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, BP n^0 2-91190 Gif-sur-Yvette, France). Phys. Rev. D 11: No. 7, 2000-2008 (1 Apr 1975).

From a unitary approximation to the nucleon-nucleon Green's function we derive the phase shifts for the Yukawa model and the nonlinear σ model. The results agree with the experimental data except for the lowest waves: $^1S_0$, $^3S_1$, $^3P_0$ where, however, we get good scattering lengths. (auth)

10358 IS A "NEW SCALING HYPOTHESIS IN HIGH ENERGY COLLISIONS" NEEDED? Svensson, B.E.Y.; Sollin, L. (Department of Theoretical Physics, University of Lund, Lund, Sweden). Phys. Rev. Lett. 34: No. 18, 1199-1201 (5 May 1975).

The experimental results used by Dao *et al.* to support a "scaling-in-the-mean" hypothesis for semi-inclusive processes can also be reproduced

by a simple *Ansatz* for the invariant cross section obeying Feynman scaling, Koba-Nielsen-Olesen multiplicity scaling, and factorization in longitudinal and transverse momenta. (auth)

10359 CONCERNING ONE MECHANISM OF "CUMULATIVE" MESON PRODUCTION. Kondratyuk, L.A.; Kopeliovich, V.B. (Institute of Theoretical and Experimental Physics). JETP Lett. 21: No. 1, 40-42 (5 Jan 1975).

It is shown that the mechanism of high-energy pion production ($E_\pi > E_d/2$) by deuterons, wherein the pion produced by one of the nucleons acquires additional energy by scattering from the second nucleon, plays an important role at nonzero components $k_{\pi\perp}$. (auth)

10360 PIONIZATION EFFECTS IN PROTON-NUCLEUS TOTAL CROSS SECTIONS. Harrington, D. R.; Julius, D. I. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Theoretische Kernphysik). Nucl. Phys., B; 88: No. 3, 411-428(7 Apr 1975).

A simple unitary model for meson production effects in proton-nucleus scattering was used earlier to estimate the pionization corrections to the proton-deuteron total cross section. This model is used to study the corresponding effects in heavy nuclei using a generalization of the optical limit. An increase in the total cross sections at the upper limit of NAL energies of roughly 20% is found. (auth)

10361 CHARGE SYMMETRY AS A CONSTRAINT ON OFF-SHELL EFFECTS IN THE THREE-NUCLEON SYSTEM. Thomas, A. W.; Afnan, I. R. (British Columbia Univ., Vancouver (Canada). Dept. of Physics). Phys. Lett., B; 55: No. 5, 425-429(17 Mar 1975).

The consequences of requiring the $^1S_0$ nucleon-nucleon interaction to be (approximately) charge symmetric are examined in the three-nucleon system. It is shown that this does restrict the off-shell variation to the extent that the binding energy of the triton (E_T), and the neutron-deuteron doublet scattering length (^2a) should lie on the Phillips line. However, it is also shown that this constraint does not significantly reduce the amount of variation in E_T(~(2 to 3) MeV) and ^2a(~1.5 fm) along the Phillips line. Furthermore, it is pointed out that for the particular transformation used, the requirement that the long range part of the nuclear force be known (the "one-pion exchange" criterion), leads to a similar constraint on the variation in E_T and ^2a to that of charge symmetry. (auth)

10362 EFFECTS OF THE NUCLEON MOTION ON THE PION-NUCLEUS SCATTERING. Cheon, I. T. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics). Phys. Lett., B; 55: No. 5, 463-465(17 Mar 1975).

The shift of the (33) resonance in the pion-nucleus scattering was investigated, taking into account the motion of the scatterer inside the nucleus. (auth)

10363 DIRECT MUON PRODUCTION IN A MULTIPERIPHERAL MODEL. Chu, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Koplik, J. (Columbia Univ., New York (USA). Dept. of Physics). Phys. Lett., B; 55: No. 5, 466-470(17 Mar 1975).

It is suggested that direct muon production in proton-proton collisions may be ascribed to familiar hadronic production mechanisms. To this end, a pion exchange multiperipheral model for massive muon pair production is constructed. The numerical results are in rough agreement with the cross sections observed at Brookhaven and more recently at Fermilab. (auth)

10364 THE NUCLEON-NUCLEON INTERACTION AND THE INTERACTION OF NUCLEONS WITH ISOBARS. Brown, G. E. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). pp 3-9 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The origin of the nucleon-nucleon interaction from the exchange of the π and ω-mesons and from two-pion exchange is discussed. The two-pion exchange term is described in a dispersion theoretical formalism, and it is shown how the $\pi\pi$ scattering phase shift $\delta^{I,J}_{\pi\pi}$ governs the strength of the σ-degrees of freedom. Going over to dynamical models, the interaction of nucleons with the N^*_{33} isobar is discussed. A model for the two-pion exchange involves the virtual isobar as intermediate state. The presence of virtual isobars is seen, perhaps most clearly, in the process $n + p \rightarrow d + \gamma$. The isobar also enters into various exchange current corrections to magnetic moments and β decay. Using any one of several simple models for the isobar, a consistent picture of the various phenomena in the two and three-nucleon systems can be achieved. (auth)

10365 A NEW FIELD THEORETICAL APPROACH TO THE NUCLEON-NUCLEON INTERACTION. Turchetti, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). pp 41-43 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A genuine field theoretical scheme, based on a variational approximation to the Green function, is proposed for the nucleon-nucleon interaction. This method and the results presented in the text are due to the collaboration of D. Bessis, W. Wortman, and the author. (auth)

10366 A NUCLEON-NUCLEON POTENTIAL THAT INCLUDES THE EFFECT OF $\Delta(1236)$. Green, A. M.; Haapakoski, P. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). pp 44-46 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A phenomenological interaction is derived by treating the NN and NΔ systems as a coupled channel problem. Two free parameters are adjusted to fit the $\delta(^1S_0)$ of NN scattering. An equivalent NN interaction is obtained by treating the NΔ system by closure. The $^1S_0$ contribution to the binding energy of neutron matter is then calculated with each of these equivalent potentials. (auth)

10367 PARITY-NON-CONSERVING NUCLEAR INTERACTION AND THE SECOND CLASS AXIAL CURRENT. Chemtob, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)); Desplanques, B. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). pp 67-69 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The two-pion exchange parity nonconserving nucleon-nucleon amplitude is examined in the covariant approach using a dispersion theory. Results are given for the pseudoscalar potentials with isospin selection rules $\Delta T = 0$, 1 and 2. It is confirmed that a sizeable contribution to $\Delta T = 1$ potentials could occur from the second class component of the axial current in the Cabibbo theory of weak interactions. (auth)

10368 KAON-IN-FLIGHT EXCITATION OF STRANGENESS ANALOG STATES. Deloff, A. (Institute of Nuclear Research, Warsaw (Poland)); Pickarz, J. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej). pp 73-76 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Strangeness-exchange reactions induced by kaons in flight on nuclei were investigated. The calculated cross sections for excitation of strangeness analog states turned out to be of the order of a few millibarns for light elements. (auth)

10369 DEUTERIUM AS A NEUTRON TARGET. Harrington, D. R. (Rutgers–the State Univ., New Brunswick, N. J. (USA). Dept. of Physics). pp 118-122 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The use of deuterium as a neutron target is discussed. Corrections to the impulse approximation due to Fermi motion, final state interactions, and double scattering are reviewed. Possible tests of the extraction procedures are also considered. (auth)

10370 NAIVE VIEW OF HIGH ENERGY HADRON-NUCLEUS COLLISIONS. Goldhaber, A. S. (Los Alamos Scientific Lab., N. Mex. (USA)). pp 133-135 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

High energy (1000 GeV) nucleon-nucleus collisions in emulsion give an indication of the nature of multiple interactions of very fast "excited hadrons". The data suggest that a cascade model of successive hadron production is not as close to the truth as a two-fireball model, in which at least the fast fireball does not disintegrate before leaving the nucleus, unless it is multiply excited by several successive collisions. (auth)

10371 SCATTERING OF HIGH ENERGY PARTICLES BY NUCLEI. Feshbach, H. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). pp 191-194 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The multiple scattering theory of Kerman, McManus, and Thaler is extended to include triple scattering effects. The triple scatter-

ing term in the optical potential is approximately proportional to the triple correlation function. The methods of Feshbach, Gal and Hufner are generalized to provide a coupled channel description of the elastic scattering of fast particles including triple scattering. The coupling potentials depend directly on the pair and triple correlation functions. Numerical calculations are performed for protons of 1.69-GeV/c momentum on ^{4}He. Center-of-mass correlations and phenomenological short-range dynamical correlations are tested using a spin-isospin averaged nucleon-nucleon amplitude. The differential cross section around the second diffraction minimum and third diffraction peak is particularly sensitive to triple scattering effects while only minor effects at the second diffraction peak are obtained. (auth)

10372 FRESNEL APPROXIMATION TO HIGH-ENERGY NUCLEAR SCATTERING. Frahn, W. E.; Schuermann, B. (Cape Town Univ. (South Africa). Dept. of Physics). pp 184-187 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Starting from Glauber's eikonal approximation, systematic approximation procedures were developed for high energy nuclear scattering which are based on two different expansions of the free-space propagator: the "eikonal expansion" and the "Fresnel expansion." In particular, the first order of the latter expansion, the Fresnel approximation, is studied for both potential scattering and multiple scattering in complex nuclei. By employing the unitary transformation that connects the Fresnel and eikonal propagators, closed expressions are derived for the potential and multiple scattering amplitudes which are formally similar to the corresponding expressions in Glauber theory. It is shown that Fresnel diffraction in high energy nuclear scattering manifests itself in a characteristic Dyson-type ordering of the effective interaction operators with respect to their z-coordinates. (auth)

10373 SOME ANOMALIES IN THE MULTIPLE PRODUCTION OF PIONS WITH LIGHT NUCLEI. The ABC and DEF Effects. Le Brun, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). pp 315-320 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The ABC effect was studied in the missing mass spectra of the reactions $n + p \rightarrow d + mm^0$, $d + p \rightarrow {}^3He + mm^0$, and $d + d \rightarrow {}^4He + mm^0$, and the DEF effect (460 MeV) was found in the second reaction. Some new interpretations are presented. (auth)

10374 MONTE CARLO SIMULATION OF THE DIFFRACTIVE EXCITATION MODEL. Kasman, J. (Westfield Coll., London (UK)). Comput. Phys. Commun.; 9: No. 3, 182-192(Mar 1975).

The diffractive excitation model for multiparticle production in proton-proton collisions provides a framework for the calculation of experimentally observable distributions, both inclusive and exclusive. The dynamics occurs in two steps: excitation of the proton into a massive cluster and de-excitation of the diffractive cluster by the subsequent emission of pions. Events are characterized by the four-momenta of two nucleons and the decay pions. Importance sampling techniques are used in the Monte Carlo simulation of a random event. The events may be analyzed exactly like those from an experimental data summary tape. (auth)

10375 THE REAL PART OF THE PROTON-PROTON DIFFRACTION AMPLITUDE AND THE ENERGY DEPENDENCE OF THE OVERLAP FUNCTIONS. Grein, W.; Guigas, R.; Kroll, P. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Theoretische Kernphysik). Nucl. Phys., B; 89: No. 1, 93-108(14 Apr 1975).

Neglecting spin effects, the pp diffractive amplitude ($0 \leq |t| \leq 3$ GeV^2; 10 GeV $\leq p \leq$ 1500 GeV) was calculated using a dispersion relation between the phase and the modulus for the crossing-even part and assuming a Regge phase for the crossing-odd part. Furthermore, the pp amplitude was transformed into the impact parameter space, and the energy dependence of the overlap functions was examined. It was found that the inelastic overlap function scales in the geometrical sense. Finally, $p\bar{p}$ scattering was studied in the same way. In this case geometrical scaling sets in only at about 300 GeV. (auth)

10376 A COORDINATE-SPACE STUDY OF KOWALSKI'S THREE-TERM SEPARABLE APPROXIMATION FOR THE FULLY OFF-SHELL TWO-NUCLEON T-MATRIX. Picker, H. S. (Trinity Coll., Hartford, Conn. (USA)); Stephenson, G. J. Jr. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Nucl. Phys., A; 241: No. 3, 443-459(14 Apr 1975).

Using elementary coordinate-space methods, it is shown that a three-term separable approximate fully off-shell T-matrix proposed by Kowalski can be reduced to a simpler expression. This T-matrix incorporates off-shell unitarity exactly, is exact half off the energy shell, and is free from the spurious poles that arise in the Noyes approximation. However, numerical tests employing the wave function model of Picker, Redish, and Stephenson show that for realistic $^1S_0$ interactions, the Noyes approximation is more accurate than Kowalski's approximation except near the spurious pole at 250 MeV. A plausible explanation is given of this result. (auth)

10377 CORRELATIONS IN THE MULTI-REGGE MODEL. Blutner, R. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). Nucl. Phys., B; 88: No. 3, 482-500(7 Apr 1975).

An N-channel Chew-Pignotti model is formulated to calculate inclusive two-particle distributions. The connection with the Muller-Regge model is explicitly established in the central and fragmentation region. The shape of the correlation function is discussed qualitatively in all kinematic regions. One and two-particle distributions for pp and π^-p interactions are calculated with parameters determined from a linear fit of f_2 and $\langle n \rangle$. The model is used to describe the pionization component in a two-component model. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 10209, 10303, 10667, 10671-10673, 10675, and 10685.

10378 (CONF-740713-, pp I.254-I.260) FERMI-BOSE SUPERSYMMETRY (SUPERGAUGE SYMMETRY IN FOUR DIMENSIONS). Zumino, B. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Fermi-Bose supersymmetry, connecting bosons with fermions, was suggested by dual models (when formulated as two-dimensional field theories) and was originally called supergauge symmetry in four dimensions. Supersymmetry algebra, supermultiplets and Lagrangians, gauge invariance and supersymmetry, superspace and superfields, Yang-Mills gauges and supersymmetry, and non-trivial mixing of internal symmetry and supersymmetry are discussed. Lines of future development are considered. (UK)

10379 (WIS-Ph-74/16) PHASES OF RESONANT AMPLITUDES $\pi N \rightarrow \rho N$. Faiman, D. (Weizmann Inst. of Science, Rehovoth (Israel)). [nd]. 16p. INIS.

2 figs.

Using $SU(6)_W$ symmetry in its 1-broken form it is found that the newly reported relative signs of $\pi N \rightarrow \rho N$ resonant amplitudes seem to indicate a universal "$SU(6)_W$-like" preference for all observed multiplets. Since the corresponding $\pi N \rightarrow \pi\Delta$ phases favor an "anti-$SU(6)_W$" solution for the 70, $L^P = 1^-$ multiplet the 1-broken $SU(6)_W$ model now faces a serious contradiction. (auth)

10380 CHIRAL-SYMMETRY BEHAVIOR AT LARGE DENSITIES. Harrington, B.J.; Yildiz, A. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 11: No. 6, 1705-1707 (15 Mar 1975).

An asymptotically free theory is considered in which chiral symmetry is dynamically broken so as to produce a fermion mass. The breakdown of chiral symmetry is gradually lost as the fermion-number density increases though the asymptotic freedom remains. The critical density at which chiral symmetry is restored is calculated in terms of the fermion mass dynamically generated at zero temperature and zero chemical potential. Our results may be of consequence in a number of physically realizable situations, as in the collision of heavy nuclei or in the core structure of neutron stars. (auth)

10381 COMMENTS ON "IS BOUND CHARM FOUND?" Pasupathy, J.; Rajasekaran, G. (Tata Institute of Fundamental Research, Bombay, India). Phys. Rev. Lett. 34: No. 19, 1250-1251 (12 May 1975).

The inadequacy of the *Ansatz* proposed by De Rújula and Glashow for explaining the meson masses is discussed. The importance of fixing the spin-parity of the abnormal parity states E (1420) and D (1285) for the possible success of SU(4) is emphasized. We also point out some further consequences of the ideas of asymptotic freedom. (auth)

10382 RESPONSE TO THE COMMENT BY PASUPATHY AND RAJASEKARAN. De Rújula, A.; Glashow, S.L. (Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 34: No. 19, 1252-1252 (12 May 1975).

We recognize the criticism made in the preceding Comment, and point out the difference between the resolution there and ours. (auth)

10383 REPRESENTATION CONSTRAINT ON ASYMPTOTIC FREEDOM IN THE HIGH-SYMMETRY LIMIT. Kang, J.S. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 11: No. 6, 1563-1568 (15 Mar 1975).

Asymptotic freedom of gauge coupling is studied in the high-symmetry limit where the rank of the symmetry group becomes large. It is shown that only particular irreducible representations for scalar and fermion multiplets are allowed in this high-symmetry limit. They are vector and tensor of the second rank (symmetric and antisymmetric) and adjoint representations. In particular, the spinor representations of the orthogonal group are ruled out. (auth)

10384 ON INFINITE DIRECT PRODUCTS OF CONTINUOUS UNITARY ONE-PARAMETER GROUPS. Reents, G. (Wuerzburg Univ. (F. R. Germany). Physikalisches Inst.). Commun. Math. Phys.; 39: No. 2, 121-130(Dec 1974).

The infinite product of unitary operators in an incomplete direct product of Hilbert spaces is discussed. Necessary and sufficient conditions are derived under which this infinite product leads to a continuous unitary one-parameter group provided each factor is assumed to have this property. A certain minimal condition guarantees the existence of a renormalized unitary group. An application is made to product representations of the canonical commutation relations in order to determine the admissible test functions. (auth)

10385 HEAVY QUARKS AND STRONG BINDING: A FIELD THEORY OF HADRON STRUCTURE. Bardeen, W.A.; Chanowitz, M.S.; Drell, S.D.; Weinstein, M.; Yan, T. (Stanford University, Stanford, California 94305). Phys. Rev. D 11: No. 5, 1094-1136 (1 Mar 1975).

We investigate in canonical field theory the possibility that quarks may exist in isolation as very heavy particles, $M_{\text{quark}} \gg 1$ GeV, yet form strongly bound hadronic states, $M_{\text{hadron}} \sim 1$ GeV. In a model with spin-1/2 quarks coupled to scalar gluons we find that a mechanism exists for the formation of bound states which are much lighter than the free constituents. Following Nambu, we introduce a color interaction mediated by gauge vector mesons to guarantee that all states with nonvanishing triality have masses much larger than 1 GeV. The possibility of such a solution to a strongly coupled field theory is exhibited by a calculation employing the variational principle in tree approximation. This procedure reduces the field-theoretical problem to a set of coupled differential equations for classical fields which are just the free parameters of the variational state. A striking property of the solution is that the quark wave function is confined to a thin shell at the surface of the hadronic bound state. Though the quantum corrections to this procedure remain to be investigated systematically, we explore some of the phenomenological implications of the trial wave functions so obtained. In particular, we exhibit the low-lying meson and baryon multiplets of SU(6); their magnetic moments, charge radii, and radiative decays, and the axial charge of the baryons. States of nonvanishing momenta are constructed and the softness of the hadron shell to deformations in scattering processes is discussed qualitatively along with the implications for deep-inelastic electron scattering and dual resonance models. (auth)

10386 SCALING LAWS FOR LARGE-MOMENTUM-TRANSFER PROCESSES. Brodsky, S.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Farrar, G.R. Phys. Rev. D 11: No. 5, 1309-1330 (1 Mar 1975).

Dimensional scaling laws are developed as an approach to understanding the energy dependence of high-energy scattering processes at fixed center-of-mass angle. Given a reasonable assumption on the short-distance behavior of bound states, and the absence of an internal mass scale, we show that at large s and t, $d\sigma/dt\ (AB \to CD) \sim s^{-n+2} f\ (t/s)$; n is the total number of fields in A, B, C, and D which carry a finite fraction of the momentum. A similar scaling law is obtained for large-$p_\perp$ inclusive scattering. When the quark model is used to specify n, we find good agreement with experiments. For instance, this accounts naturally for the $(q^2)^{-2}$ asymptotic behavior of the proton form factor. We examine in detail the field-theoretic foundations of the scaling laws and the assumption which needs to be made about the short-distance and infrared behavior of a bound state. (auth)

10387 GENERAL THREE-DIMENSIONAL SUPERLUMINAL TRANSFORMATIONS AND TACHYON KINEMATICS. Antippa, A.F. (Département de Physique, Université du Québec, Trois-Rivières, Québec, Canada). Phys. Rev. D 11: No. 4, 724-739 (15 Feb 1975).

The existence of a preferred axis in space, called the tachyon corridor, has recently been proposed in order to generalize the one-dimensional causal theory of tachyons to three dimensions. We use this theory to derive the general transformation equations between inertial frames with superluminal relative velocities in a three-dimensional space. The kinematics of tachyons, as well as luxons emitted by them, are then worked out and several characteristics of the tachyon corridor follow from them. These provide the means for determining the direction of the tachyon corridor. (auth)

10388 SUPPRESSION OF THE GOLDSTONE BOSON IN A GROSS-NEVEU MODEL. Root, R.G. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 11: No. 4, 831-837 (15 Feb 1975).

We calculate to order $1/N$ the effective potential for two N-component massless fermion theories in two space-time dimensions. The order-one approximation to the effective potential predicts symmetry breaking for both theories. The order-$1/N$ approximation leads to discrete-symmetry violation, but the continuous-symmetry model is no longer broken, in agreement with a general theorem. The complete $1/N$ expansion is then reformulated in terms of vacuum graphs involving resummed propagators and nonlocal vertices. The lth-order contribution then involves only a finite number of graphs, each having l loops. (auth)

10389 SUPERSYMMETRY CURRENTS IN THE PRESENCE OF SYMMETRY BREAKING. de Wit, B. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. D 11: No. 4, 898-904 (15 Feb 1975).

We discuss two aspects of the supersymmetry currents in the presence of symmetry breaking. First, we find that the algebra of supersymmetry charges is affected by the breaking. We will argue that this is also the case if the supersymmetry is realized in a spontaneously broken way. Secondly, we show that amplitudes that contain one supersymmetry current can be regularized consistently if the current is modified in a way that follows from our regularization scheme. (auth)

10390 GAUGE INVARIANCE IN SPONTANEOUSLY BROKEN SYMMETRY. Fischler, W.; Brout, R. (Faculté des Sciences, Université Libre de Bruxelles, Bruxelles, Belgium). Phys. Rev. D 11: No. 4, 905-908 (15 Feb 1975).

A gauge-invariant approach to an effective potential in the presence of spontaneously broken symmetry is formulated. (auth)

10391 CAUSALITY, EQUAL-TIME ALGEBRA, AND LIGHT-CONE COMMUTATORS. Abdel-Rahman, A-M.; Taha, M.O. (Department of Physics, University of Khartoum, Khartoum, Sudan). Phys. Rev. D 11: No. 4, 924-934 (15 Feb 1975).

Extending previous work we discuss the sum rules that follow from causality, scaling and equal-time algebra for the nonforward (spinless) single-particle matrix element of the commutator of two conserved vector currents, using the recently introduced refined infinite-momentum technique. The complete set of sum rules is found to include those obtained from light-cone commutators. It also contains some additional ones. (auth)

10392 SYMMETRY VIOLATIONS. Henley, E. M. (Washington Univ., Seattle (USA). Dept. of Physics). pp 22-32 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The present experimental and theoretical status of some inexact symmetries is reviewed. Starting with hadronic interactions, which break SU(3), the presentation passes through the electromagnetic interactions which break isospin and possibly time reversal invariance. The discussion ends with the weak interactions and related symmetries, namely those associated with the weak currents and with parity, primarily in hadronic systems. Experiments that can shed further light on the symmetry-breaking effects are suggested. (auth)

10393 THE CONNECTION BETWEEN SUPERSYMMETRY AND ORDINARY LIE SYMMETRY GROUPS. Goddard, P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., B; 88: No. 3, 429-441(7 Apr 1975).

The mathematical structure of supersymmetry groups and their representations is discussed. Corresponding ordinary Lie algebras are constructed. O'Raifeartaigh's theorem applies, and these groups realize one of the possibilities it permits, namely, the Lie algebra is the semidirect product of a semisimple Lie algebra and a solvable non-Abelian Lie algebra. The usual difficulties with such algebras are avoided because it is represented in a space whose coordinates do not form a field. The theorem of Coleman and Mandula is not directly applicable because the Hilbert space of physical states is not invariant under the action of the group. It is possible to consider an extended space of states and to define an "inner product" which is preserved by the action of the group, but this product is not positive definite. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 10228 and 10236.

10394 (CONF-740713-, pp II.162-II.163) ARE NON 35 TERMS NEEDED IN RESONANCE COUPLINGS? Osborn, H. (Cambridge Univ., Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

There has been considerable success in correlating resonance pionic decays and also their photonic couplings with ideas based on the Melosh transformations. These results have been founded on assuming that the axial charge, for pionic transitions, or the electromagnetic current, for real photons, transforms like components in a 35 under $SU(6)_W$. A theorem is given which casts doubt on the requirement of just keeping 35 pieces. It is considered that the Melosh transformation, whatever it is in a realistic interacting case, is more than a simple rotation of the individual quark spins. It is possible that $SU(6)_W$ is intrinsically inexact, good to only a rough approximation, perhaps 20 to 50%. (UK)

10395 (CONF-740713-, pp III.23-III.57) WEAK DECAYS AND CP VIOLATION. Kleinknecht, K. (Univ., Dortmund, Ger.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Recent experimental progress covering weak decays and CP violation are considered under the following headings: (1) CP conserving decays; μ^+ lifetime, Λ lifetime, K_S lifetime, baryon leptonic decays, $\Delta Q/\Delta S$ rule, $\Xi^0 \to \Lambda\gamma$. (2) Search for neutral currents; $K^+ \to \pi^+e^+e^-$, $K_L \to \mu\mu$. (3) CP violation; CP violation in K^0 decays, phenomenology, $K_L - K_S$ mass difference, measurements of $|\eta_+|$, measurements of ϕ_+, $|\eta_{00}|$ and ϕ_{00}, charge asymmetry in $K_L \to \pi l\nu$, present status of CP violation parameters, searches for CP violation and C violation outside the K^0 system, charge asymmetry in η and η' decays, search for the electric dipole moment of the neutron. It is concluded that: (1) The Fermi coupling constant is known to a precision of 2×10^{-5} provided second order radiative corrections are calculated to this level. (2) The Cabibbo structure of currents for baryon leptonic decays is confirmed to a very high level of confidence. Therefore models of unified theories not incorporating this structure have to be discarded. (3) No evidence for a violation of the $\Delta Q = \Delta S$ rule in charged currents exists. (4) No evidence for $\Delta S = 1$ semileptonic neutral weak currents exists. (5) The experimental information on CP violation is in good agreement with the superweak model, but milliweak models cannot be excluded by the K^0 experiments at this time. The detection of an electric dipole moment of the neutron or an upper limit on this quantity with a sensitivity of $D_n/e < 10^{-24}$ cm could however allow a choice between these two classes of models. (6) T is violated and no evidence for CPT violation exists in K^0 decays. An extensive bibliography is included. (119 references) (UK)

10396 (CONF-740713-, pp IV.88-IV.89) SCALING IN PARTON MODELS. Polkinghorne, J. C. (Cambridge Univ., Eng.). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Partons now appear pointlike but doubtless a regime will come in which they have a discernible size—this is discussed. The next-to-leading order correction term in parton models is also considered. Canonically these are expected to be of order ν^{-1} but non-canonical behavior $\nu^{-\epsilon}$ ($\epsilon < 1$) is possible. It is an interesting result that ϵ must be less than $\frac{1}{2}$ in "stretched" parton models, that is those which give large final state multiplicities. (UK)

10397 (CONF-740713-, pp IV.90-IV.94) LEPTON PHYSICS AND GAUGE THEORIES. De Rujula, A. (Harvard Univ., Cambridge, MA). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The progress in gauge theories of the weak and electromagnetic interactions and lepton physics, gauge theories of the strong interactions, and the breakdown of scaling in electron and neutrino scattering is reviewed with reference to papers presented to the XVII International Conference on High Energy Physics, London. (1974). The review is presented under the headings: (1) Inclusive neutrino scattering in unified gauge theories. (2) The breakdown of Bjorken scaling in gauge theories of the strong interactions. (UK)

10398 ANOMALOUS ALGEBRAS AND NEUTRINO SUM RULES. Bég, M.A.B. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 11: No. 5, 1165-1170 (1 Mar 1975).

Some popular neutrino sum rules and the underlying algebra, which is anomalous in the sense that it cannot be realized in any finite (nontrivial) order of perturbation theory, are examined within the framework of the renormalization group. For asymptotically free theories, the leading corrections to these sum rules—at large but finite energies—are evaluated. The use of sum rules as an experimental probe into the structure of gauge models and the nature of charm is discussed in the light of these considerations. (auth)

10399 VACUUM STABILITY AND THE CABIBBO ANGLE. Pagels, H. (Institute for Theoretical Physics, State University of New York, Stony Brook, Long Island, New York 11794). Phys. Rev. D 11: No. 5, 1213-1219 (1 Mar 1975).

It is shown that vacuum stability determines the Cabibbo angle θ_C. From a simple example we obtain $\tan^2\theta_C \simeq f_\pi\mu_\pi{}^2 / f_K\mu_K{}^2$ and a nonelectromagnetic $\Delta I = 1$ interaction. The effect of charm is included. We also discuss the superweak model of CP violation as an isotopic rotation through an angle θ_{CP}. (auth)

10400 PARITY VIOLATION IN THREE-TRIPLET GAUGE MODELS. Andrašı, A.; Missimer, J.; Tadić, D. (Institute "Rudjer Bošković" and University of Zagreb, Zagreb, Croatia, Yugoslavia). Phys. Rev. D 11: No. 5, 1331-1336 (1 Mar 1975).

Enhancement of the parity-violating isospin-changing one-pion-exchange potential for three-triplet gauge models has been found with respect to the standard weak-Hamiltonian model. In the case of the Bég-Zee model, which allows for the neutral hadron-current coupling to neutrinos, there is an enhancement by at least a factor of 10. The Lee-Prentki-Zumino and the Georgi-Glashow models are also discussed. The role of Fierz transformations has been investigated in detail. It has been suggested that the detection of an angular γ asymmetry comparable with circular γ polarization in thermal-neutron capture, as well as larger resonance than expected in the decay process of lithium, can be meaningful substantiation of unified theories of weak and electromagnetic interactions. (auth)

10401 VANISHING NINTH AXIAL CHARGE AND THE π-η PROBLEM. Bars, I. (Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305); Halpern, M.B. Phys. Rev. D 11: No. 4, 956-957 (15 Feb 1975).

We remark that the mechanism of one of our previous explicit M models, proposed to solve the π-η problem, is equivalent to the vanishing of the ninth axial charge. It is suggested that a similar mechanism might work in a quark-gluon model dynamically. (auth)

10402 AXIAL-VECTOR ANOMALY IN K_L AND RELATED DECAYS. Gavrielides, A. (Department of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. D 11: No. 7, 1884-1895 (1 Apr 1975).

$K_L \to 2\gamma$ decay is examined in the context of gauge models of weak and electromagnetic interactions. It is shown that the decay is possible because of the existence of an anomaly in the divergence of the axial-vector current that transforms like λ_8 under SU(3). The existence of such an anomaly is first shown in an $SU(2) \times U(1)$ gauge model containing only the familiar quarks, and then generalized and calculated for the realistic case of the SU(4) model of Glashow, Iliopoulos, and Maini. The $K_L \to 2\gamma$ rate is obtained as a function of the amount of SU(4) breaking, which is determined to be of the order of 1.5 GeV^2. In addition, the $K_L \to \bar{\mu}\mu$ decay is examined within the context of the above models and is shown to be sufficiently suppressed. Moreover, the examination of $K_S \to \pi^+\pi^-$ decay and the $K_L \to K_S$ mass difference leads to an interesting relation independent of mass parameters. Also, in the case of the SU(4) model, the calculation of those processes leads to the determination of the quark mass parameters. (auth)

10403 (8,8) CHIRAL-SYMMETRY BREAKING AND THE $K_{\mu 4}$-DECAY FORM FACTORS. Sastry, C.V.; Tiwari, T.N. (Department of Mathematics, Regional Engineering College, Rourkela 769008, Orissa, India). Phys. Rev. D 11: No. 7, 1979-1985 (1 Apr 1975).

The form factors for $K_{\mu 4}$ decay have been calculated using the (8,8) representation of broken chiral symmetry. The results compare favorably with available experimental data. (auth)

10404 WEAK DECAYS OF CHARMED HADRONS. Kingsley, R.L.; Treiman, S.B.; Wilczek, F.; Zee, A. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 7, 1919-1923 (1 Apr 1975).

SU(3) relations among various two-body channels in weak decays of charmed hadrons are worked out in the framework of the four-quark model of the weak interactions. Effects analogous to K^0, $\bar{K}^0$ mixing are discussed for charmed mesons. A certain dominance possibility, analogous to octet dominance for charm-conserving weak reactions, is noted. (auth)

10405 GENERAL APPROACH TO WEINBERG'S MODEL WITH THREE TRIPLET QUARKS. Bender, I. (Heidelberg Univ. (F. R. Germany). Inst. fuer Hochenergiephysik); Gromes, D.; Koener, J. (Heidelberg Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., B; 88: No. 3, 525-547(7 Apr 1975).

All possible $SU(2) \times U(1)$ gauge models with three triplet quarks are classified according to the representations of the quarks, requiring the validity of the Cabibbo theory and absence of strangeness changing neutral processes in lowest order. Then the questions of lepton-hadron universality, $\Delta S \neq 0$ neutral processes in higher orders, and strong interactions are investigated in detail. Characteristic differences between the various types of

models show up. Further the predictions for the ratios R and $\bar{R}$ of neutral to charged ν and $\bar{\nu}$ cross sections below color threshold are given. Only a rather small region of the R–$\bar{R}$ plane is accessible by the totality of all the models. The experimental points lie within this region, and more precise measurements could well discriminate between the various types of models. (auth)

Applications (Strong)

Refer also to abstracts 10319 and 10474.

10406 (CONF-740713-, pp II.120-II.133) $SU(6)_W$ AND DECAYS OF BARYON RESONANCES. Hey, A. J. G. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Baryon classification and $SU(6)_W$ theory are discussed briefly. Considering pseudoscalar meson decays the basic model for $A \rightarrow B\pi$ is $\langle A\ B\pi\rangle \sim (M_A^2 - M_B^2)\ \langle A\ Q_5^\pi\ B\rangle$ where the mass factor comes from PCAC, and the $SU(6)_W$ predictions are made assuming B to be the ground state $(56,0^+)$ multiplet, A to be the $(70,1^-)$ and $(56,2^+)$ multiplets, and Q_5^π to transform as the sum of two terms belonging to a 35. New data are discussed and results presented in tabular form. From these it is seen that: (1) The $(56,2^+)$ decays work well with no mixing. 27 measurements of $\sqrt{\chi\chi'}$ are fitted to P, F. (2) The $(70,1^-)$ decays work well with little mixing: 54 measurements of $\sqrt{\chi\chi'}$ and one partial width are fitted to S, D and the mixing angles. From an $(SU(6)_W)$ analysis of baryon resonance decays into pseudoscalar mesons it is concluded that: (1) $SU(6)_W$ schemes are very successful in correlating a large amount of data. (2) Baryon resonances are to a reasonable approximation pure $SU(6)_W$ spin states. (UK)

10407 HOW TO CONSTRUCT A RELATIVISTIC SU(6) CLASSIFICATION SYMMETRY GROUP. Fuchs, N.H. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 11: No. 6, 1569-1579 (15 Mar 1975).

A relation between the algebra of $SU(6)_{W,\text{current}}$ and that of $SU(6)_{W,\text{strong}}$ is given for the quark model with arbitrary interaction as quantized on a null plane. A unitary transformation is constructed which connects the generators of the algebras in such a way that the generators W_i^a of $SU(6)_{W,\text{strong}}$ classify states independent of momentum. The W_i^a are shown to have the simple angular momentum properties expected in the naive quark model. For the free-quark model, the results reduce essentially to those of Melosh, although no problems involved in the use of wave packets arise here. (auth)

10408 THREE-POINT FUNCTIONS, CHIRAL SYMMETRY, AND THE WILSON EXPANSION. Auvil, P.R.; Pritchett, P.L. (Department of Physics, Northwestern University, Evanston, Illinois 60201). Phys. Rev. D 11: No. 5, 1158-1164 (1 Mar 1975).

We have extended a previous analysis of two-point functions, which was based on the $(3, \bar{3})$ model of chiral symmetry breaking and the Wilson short-distance expansion, to the three-point functions of the model. We obtain additional consistency requirements which now determine all parameters of the model in terms of the pseudoscalar masses plus $F_K/F_\pi f_+(0)$, as determined from K_{l3}, K_{l2}, and π_{l2} decay. λ_0 (the slope of the scalar K_{l3} form factor) is predicted to be $\lambda_0 \simeq 0.016$. From this solution, we calculate the rate for $\eta' \rightarrow \eta\pi\pi$, but find a small result, in accord with previous calculations. We also find one relation between masses of the two scalar, isoscalar particles of the model. (auth)

10409 CHIRAL SYMMETRY AND THE QUARK MODEL. Carlitz, R.; Heckathorn, D.; Kaur, J.; Tung, W. (The Enrico Fermi Institute and The Department of Physics, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. D 11: No. 5, 1234-1250 (1 Mar 1975).

The construction of chiral-symmetric quark models is investigated. We show that the Nambu-Goldstone realization of chiral symmetry leads naturally to representation mixing of quark states and of their composites. Constructing SU(6) wave functions for hadron states, we obtain a mixing scheme algebraically equivalent to the Melosh transformation. The resulting phenomenology for pionic decays and for weak and electromagnetic vertices is known to be very successful. The present work provides a theoretical basis for these results and opens new avenues for the study of SU(6) symmetry and the investigation of deep-inelastic scattering processes. (auth)

10410 EXOTIC PROCESSES AND CHIRAL-SYMMETRY BREAKING. Brehm, J.J. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. D 11: No. 5, 1262-1266 (1 Mar 1975).

We use current algebra and unitarity to develop expressions for the *s*-wave phase shifts for $\pi\pi$ (isospin 2) and $K\pi$ (isospin 3/2). The constants appearing in the parametrization can be determined from refined phase-shift phenomenology. They provide direct information about the exotic components of the σ commutator, to which these exotic states are coupled, and thus about chiral-symmetry breaking. We illustrate in terms of a model of supplementary symmetry breaking which is of (8,8) form. (auth)

10411 MODEL FOR CHIRAL SU(4) ⊗ SU(4) BREAKING BASED ON THE (15, 15) REPRESENTATION. Deshpande, N.G.; Dicus, D.A. (Center for Particle Theory, The University of Texas at Austin, Austin, Texas 78712). Phys. Rev. D 11: No. 5, 1287-1297 (1 Mar 1975).

We investigate (15, 15) breaking for SU(4) ⊗ SU(4) symmetry breaking as an alternative to the (4*, 4) model. The form for the Hamiltonian is so chosen that pions obey the PCAC (partially conservation of axial-vector current) equation, and the parameters in the Hamiltonian are then determined by meson dominance. The Hamiltonian is found to be SU(3)⊗ SU(3) -invariant to a very good approximation, permitting charmed mesons to be massive and thus escape detection. We also evaluate π-π scattering lengths and the decay $X \rightarrow \eta\pi\pi$ in this model. Other choices of Hamiltonians within (15, 15) breaking are also considered, but shown to be unsatisfactory. (auth)

10412 U(3) ⊗ U(3) SYMMETRY MODEL WITH ISOSPIN BREAKING. Kapoor, A.K. (Department of Physics, Indian Institute of Technology, Kanpur 208016, India). Phys. Rev. D 11: No. 7, 1841-1855 (1 Apr 1975).

Mesonic and baryonic interactions are studied in a model of chiral U(3) ⊗ U(3) symmetry. The scalar and pseudoscalar mesons are assumed to belong to the $(3, 3^*) \oplus (3^*, 3)$ representation. Nonets of vector and axial-vector fields are introduced as gauge fields. The baryons are assumed to transform as the $(3, 3^*) \oplus (3^*, 3)$ representation. Explicit and spontaneous symmetry breakings are introduced and masses and various couplings are obtained. Most of the parameters are fixed by using some particle masses as input. We find that the Lagrangian is approximately invariant under SU(2) ⊗ SU(2) while for the vacuum SU(3) is a better symmetry than SU(2)⊗SU(2). The scalar-meson masses are predicted to be $m_{S_\pi} = 949$ MeV, $m_{SK} = 1025$ MeV, $m_{S\eta} = 1068$ MeV, and $m_{S\eta'} = 694$ MeV. The $V \rightarrow PP$, $A \rightarrow VP$, $S \rightarrow PP$, and the three-body decay models $A \rightarrow 3P$ are calculated, which compare well with the experiments. The meson-meson scattering lengths and effective ranges are calculated and compared with experiments and the current-algebra results. The mesonic decay constants and the K_{l3} form factors are calculated, and we have $F_K/F_\pi = 1.04$, $F_{S_K}/F_\pi = -0.14$, $f_+(0) = 0.99$, $\xi = -0.24$, $\lambda_+ = 0.021$, and $\lambda_- = -0.022$. The *BBP* coupling constants and some of the meson-baryon scattering lengths, however, do not agree with the experiments. The nonelectromagnetic isospin-violating effects are studied and it is found that a single value of a parameter characterizing the strength of these interactions does not explain the following three results: (i) the electromagnetic mass differences of pseudoscalar mesons, (ii) the $\eta \rightarrow 3\pi$ decay parameters, and (iii) the baryon electromagnetic mass differences. (auth)

10413 TESTING THE LOW-ENERGY THEOREMS OF BROKEN CHIRAL AND CONFORMAL SYMMETRIES. Cornwell, D.T.; Genz, H.; Steiner, H. (Institut für Theoretische Kernphysik der Universtität Karlsruhe, D75 Karlsruhe, Germany); Eliezer, S. Phys. Rev. D 11: No. 7, 1856-1863 (1 Apr 1975).

We test the low-energy theorems of broken chiral and conformal invariance by use of the experimental $\pi\pi$ phases up to $m_{\pi\pi} = 1$ GeV. Our method differs considerably from a previous treatment by Renner and Staunton. Nevertheless, in the $(3, \bar{3}) \oplus (\bar{3}, 3)$ model considered by these authors we recover their result that no consistent solution exists. The same result is obtained for the (8, 8). In a mixed model a consistent solution is found. This model has been introduced previously by the authors in order to be able to cope with a large $\pi\pi$ scattering length $a_0^{(0)}$. Our assumptions include that δ is a *c* number and that *u* has dimension two, in agreement with the low-energy theorems we use. (auth)

10414 MESON DECUPLETS IN THE SU(4) × SU(4) SCHEME. A Possible Explanation of Narrow $e^+ - e^-$ Resonance. Vergara Caffarelli, R. (Pisa Univ. (Italy). Istituto di Fisica). Phys. Lett., B; 55: No. 5, 481-485(17 Mar 1975).

The SU(4) × SU(4) scheme provides a "unified" mass formula well satisfied by the 0^-, 1^-, and 2^- nonets. The $(4,\bar{4}) + (\bar{4},4)$ representation of SU(4) × SU(4) allows the accommodation of a decuplet of 0^- noncharmed particles and consequently enables the solution of the $\eta - X_0 - E$ mixing problem. SU(4) × SU(4) also provides a scheme for explaining the recently discovered narrow $e^+ - e^-$ resonance. (auth)

10415 SYMMETRIES RELATED TO THE QUARK MODEL. Ne'eman, Y. (Tel Aviv Univ. (Israel)). pp 10-21 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The conceptual foundation relating three lines of work which have sprung out of SU(3) since 1964 is studied: current algebra, the supermultiplet (SU(6) etc.) symmetries based upon a non-

relativistic quark model, and the algebra of complex-J vertex-strengths. The latter embodies the results derived heuristically from an "independent quark model" in high energy processes. Several unitary transformations enable the weak and electromagnetic currents to be used as a canonical basis, though one could now also invert the sequence and start from strong-interaction quarks defined by high energy asymptotics. (auth)

Scattering Theory

Refer also to abstracts 10298, 10577, and 10662.

10416 (CONF-740713-, pp I.168-I.172) EXTRACTING SCATTERING AMPLITUDES FROM INCOMPLETE DATA. Kane, G. (Univ. of Michigan, Ann Arbor). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

It is shown how general analyticity properties of scattering amplitudes can be combined with data on cross sections and transverse polarizations to extract amplitudes from data in a practical way. (UK)

10417 CONSTRUCTION OF A MEROMORPHIC MANY-CHANNEL p-WAVE S MATRIX. Cox, J.R.; Garcia, H.R. (Department of Physics, Florida Atlantic University, Boca Raton, Florida 33432). J. Math. Phys. (N.Y.) 16: No. 7, 1402-1409 (July 1975).

The simplest possible nonrelativistic many-channel p-wave S matrix which is meromorphic on its energy Riemann surface, as well as the underlying potential matrix, is explicitly constructed by means of the many-channel Marchenko equations. The results suggest that, contrary to the case in which no coupling between channels is present, such an S matrix necessarily increases in complexity with increasing angular momentum. (auth)

10418 ON ANGULAR MOMENTUM AND CHANNEL COUPLING FOR A MEROMORPHIC MANY-CHANNEL S MATRIX. Cox, J.R. (Department of Physics, Florida Atlantic University, Boca Raton, Florida 33432). J. Math. Phys. (N.Y.) 16: No. 7, 1410-1415 (July 1975).

We consider a class of possible (i.e., not known *a priori* to be unitary) nonrelativistic many-channel S matrices meromorphic on their energy Riemann surfaces whose general form is suggested by the inverse scattering problem. These possible S matrices are associated with n (spinless) coupled channels of the same angular momentem l, and they reduce, in the one-channel limit, to the quotient of two polynomials of degree $2m$ in the wavenumber k. It is shown that the assumptions which imply unitarity for real energies of the open-channel submatrix also imply that no channels can be coupled when $m \leqslant l$. (auth)

10419 ANALYTIC T MATRICES FOR COULOMB PLUS RATIONAL SEPARABLE POTENTIALS. van Haeringen, H.; van Wageningen, R. (Natuurkundig Laboratorium der Vrije Universiteit, Amsterdam, The Netherlands). J. Math. Phys. (N.Y.) 16: No. 7, 1441-1452 (July 1975).

The $l=0$ partial wave projected Coulomb off-shell T matrix $T_{c,l=0}$ in momentum representation is obtained in closed form. Problems existing in the literature concerning the half- and on-shell behavior of T_c and $T_{c,l}$ are discussed and clarified by means of explicit formulas. The remaining derivations in this paper are based on $T_{c,l=0}$. We consider the class of N-term separable potentials where the form factors are rational functions of p^2 (in momentum representation). We prove that the $l=0$ T matrix corresponding to the Coulomb potential plus any such so-called rational separable potential has a very simple form, namely, it can be written in terms of rational functions and the (simple) hypergeometric function with parameters $(1, i\gamma; 1+i\gamma)$, where γ is the well-known Coulomb parameter. Explicit analytic formulas are derived for a number of simple members of the class, the Yamaguchi potential being one of them. In this particular case the expressions of Zachary and of Bajzer are reproduced who used a method based on the O_4 symmetry. (auth)

10420 HIGH-ENERGY POTENTIAL SCATTERING OF DIRAC PARTICLES. Bui-Duy, Q. (Centre de Recherches Mathématiques, Université de Montréal, P.Q., Canada). Phys. Rev. D 11: No. 6, 1635-1638 (15 Mar 1975).

A general method for studying the high-energy potential scattering of Dirac particles is presented. The failure of the usual eikonal picture for a pseudoscalar potential is attributed to competing pair-production processes. (auth)

10421 ONE-DIMENSIONAL MODEL OF THE REARRANGEMENT AND DISSOCIATION PROCESSES AND THE FADDEEV EQUATIONS. II. Lipszyc, K. (Institute of Physical Chemistry, Polish Academy of Sciences, Warsaw, ul. Kasprzaka 44/52, Poland). Phys. Rev. D 11: No. 6, 1649-1661 (15 Mar 1975).

In this paper the author continues the study of the Faddeev-Lovelace equations for the one-dimensional boundary-condition model of three particles. The half-off-shell rearrangement and elastic amplitudes are constructed explicitly for the general case of a model with arbitrary mass ratios and arbitrary strengths for the two-body interactions. These exact amplitudes are shown to satisfy the modified form of the coupled Faddeev-Lovelace equations as well as the equation relating them to the probability amplitude of the dissociation process. (auth)

10422 POTENTIAL SCATTERING IN THE EIKONAL APPROXIMATION. II. Byron, F.W. Jr. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002); Joachain, C.J.; Mund, E.H. Phys. Rev. D 11: No. 6, 1662-1672 (15 Mar 1975).

A systematic study is made of several properties of the eikonal approximation and related methods. We first discuss various corrections to the eikonal approximation, in particular the eikonal–Born series method and the eikonal expansion of Wallace. We then show that the eikonal approximation satisfies unitarity in a very special way. Finally, we analyze in detail the very-strong-coupling situation. We show that in this case, and if the incident wave number is sufficiently large, the eikonal approximation yields excellent results for small-angle scattering. (auth)

10423 s- AND t-CHANNEL UNITARITY EQUATIONS IN THE COHERENT-STATE REPRESENTATION. Botke, J.C.; Fulco, J.R. (Department of Physics, University of California, Santa Barbara, Santa Barbara, California 93106); Pignotti, A. Phys. Rev. D 11: No. 6, 1673-1687 (15 Mar 1975).

Using the coherent-state representation we write down a set of relations that must be satisfied by scattering amplitudes having full s-channel and elastic t-channel unitarity. While general solutions to this set of equations have not been found, we discuss several models that illustrate certain aspects of the problem. In particular we show that the "Born term" in the t-channel equation must itself satisfy full s-channel unitarity. Some properties of functional integration are discussed. (auth)

10424 TWO-PARTICLE SCATTERING AMPLITUDES WITH SPIN-INDEPENDENT POINCARÉ-TRANSFORMATION PROPERTIES. Tindle, G.L. (Department of Physics, Queen Mary College, University of London, Mile End Road, London, E. 1, England). Phys. Rev. D 11: No. 6, 1688-1700 (15 Mar 1975).

For systems of massive particles with arbitrary spins we define complete sets of invariant c.m. helicity amplitudes. We construct the associated partial-wave amplitudes and give a detailed derivation of the constraint equations which they must satisfy if scatteirng processes are to be invariant under space-time translations and proper homogeneous Lorentz transformations. We then indicate how these amplitudes are related to those of Jacob and Wick and Feldman and Matthews. In appendixes we collect together the definitions and transformation properties of various two-particle states and scattering amplitudes, and derive some useful kinematical transformation formulas. (auth)

10425 EXTENSION OF THE NEW TAMM–DANCOFF METHOD TO PHASE TRANSITIONS IN MANY-BODY SYSTEMS. Friederich, A.; Gerling, W.; Bleuler, K. (Bonn Univ. (F. R. Germany). Inst. fuer Theoretische Kernphysik). Z. Naturforsch., A; 30: No. 2, 142-157(Feb 1975). (In German).

The New Tamm–Dancoff method is extended by introducing intermediate states. In this way one can treat with the Green's function method the effect of nearby levels in many-body systems. As an example one studies intensively "the Hartree–Fock theory with intermediate states". The Hartree–Fock theory with intermediate states and RPA with intermediate states are applied to the exactly solvable Lipkin model. (auth)

10426 BETHE'S HYPOTHESIS AND FEYNMAN DIAGRAMS: EXACT CALCULATION OF A THREE-BODY SCATTERING AMPLITUDE BY PERTURBATION THEORY. Thacker, H.B. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. D 11: No. 4, 838-847 (15 Feb 1975).

The perturbation series for three-body scattering is discussed and summed to all orders in a nonrelativistic one-dimensional theory with δ-function interaction. The summation is accomplished by analyzing three simultaneous integral equations satisfied by the three-body scattering amplitude and appropriately decomposing and recombining the kernels which appear in these equations. The homogeneous integral terms can be entirely eliminated from one equation in favor of the scattering amplitude itself, yielding an algebraic equation which is easily solved. The three-particle incoming wave function in configuration space is constructed from the scattering amplitude and shown to be that given by Bethe's hypothesis. (auth)

10427 NEW FADDEEV-TYPE EQUATIONS FOR THE THREE-BODY PROBLEM. Karlsson, B.R.; Zeiger, E.M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 11: No. 4, 939-946 (15 Feb 1975).

We present new Faddeev-type equations for the three-body problem. Although obtained from the rigorous Faddeev theory, they only require two-body bound-state wave functions and *half-off-shell* transition amplitudes as input. In addition, their "effective potentials" are

independent of the three-body energy, and can easily be made real after an angular momentum decomposition. The equations are formulated in terms of physical transition amplitudes for three-body processes, except that in the breakup case the partial-wave amplitudes differ from the corresponding full amplitudes by a Watson final-state interaction factor. (auth)

10428 NEW FADDEEV-TYPE EQUATIONS FOR THE THREE-BODY PROBLEM WITH SINGULAR CORE INTERACTIONS. Kim, Y.E.; Tubis, A. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 11: No. 4, 947-952 (15 Feb 1975).

Karlsson and Zeiger (KZ) have recently derived new Faddeev-type equations for amplitudes directly related to physical three-body T-matrix elements. Their equations have effective potentials which are independent of the three-body energy, and have only two-body bound-state wave functions and half-off-shell scattering amplitudes as input. We generalize the KZ equations so they are applicable to two-body singular core interactions described by the boundary-condition model. The basic features of the original KZ equations are retained. (auth)

10429 COMMENT ON "FORMAL SCATTERING THEORY WITH SHADOW STATES". Newton, R.G. (Physics Department, Indiana University, Bloomington, Indiana 47401). Phys. Rev. D 11: No. 4, 958-959 (15 Feb 1975).

It is pointed out that examination of a double-scattering experiment reveals an inconsistency in the scattering theory proposed by Richard in connection with Sudarshan's "shadow states." The theory gives different amplitudes for a double-scattering experiment, depending on the stage at which the "shadow world" is eliminated from explicit reference. (auth)

10430 MANY-PARTICLE FINAL STATES AND THE ENERGY DEPENDENCE OF CHARGE EXCHANGE AND MOMENTUM TRANSFER. Weingarten, D. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 11: No. 7, 1924-1929 (1 Apr 1975).

An inequality restricting the energy dependence of two-body reactions which transfer any combination of charge and momentum is derived using the assumption that a class of many-particle production events fulfills the requirement of local compensation of quantum numbers. (auth)

10431 SPIN TESTS AND AMPLITUDE ANALYSIS FOR THE REACTION $0 + 1/2 \rightarrow 0 + J$. Donohue, J.T. (Laboratoire de Physique Théorique, Université de Bordeaux 1 and Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 11: No. 7, 1935-1939 (1 Apr 1975).

A complete set of equations is found which relate the spin J of a fermion resonance, certain bilinear forms in the statistical tensors $t_L{}^M$ (with L even), and the degree of target polarization for the reaction $0 + 1/2 \rightarrow 0 + J$ on a polarized target. For the case of production on an unpolarized target, the helicity amplitudes, to within a four-parameter ambiguity, are explicitly constructed from the even-L $t_L{}^M$ and a complete set of trilinear constraints among the latter is obtained. (auth)

10432 OPTICAL THEOREMS FOR THREE-TO-THREE PROCESSES. Coster, J. (Physics Department, Western Illinois University, Macomb, Illinois 61455); Stapp, H.P. J. Math. Phys. (N.Y.) 16: No. 6, 1288-1323 (June 1975).

Optical theorems for three-to-three processes are derived from S-matrix principles. These theorems express all single, double, and multiple discontinuities across all combinations of normal threshold cuts in terms of physical scattering amplitudes. The 2^{16} functions corresponding to all combinations of sides of the 16 normal threshold cuts are determined by analyticity requirements and the generalized Steinmann relations. These two conditions guarantee that these functions can be identified with the corresponding functions in the Regge discontinuity formulas of Weis. This identification provides for a possible enlargement of the scope of Regge–Mueller-type analyses of high-energy processes. (auth)

10433 SEPARABLE OPERATOR EXPANSIONS FOR THE T-MATRIX. Adhikari, S. K.; Sloan, I. H. (New South Wales Univ., Kensington (Australia)). Nucl. Phys., A; 241: No. 3, 429-442 (14 Apr 1975).

A general scheme is developed for constructing finite-rank approximations to the t-matrix. The emphasis is on obtaining approximations that are good in a particular context (specifically, in the kernel of few-body problems), rather than on attaining good pointwise accuracy. The scheme in its most general form makes use of two arbitrary sets of expansion functions, and various choices for these functions are considered, and their virtues assessed. Other expansion methods (Weinberg series, unitary pole expansion, and the expansion of Ernst, Shakin and Thaler) can be obtained from the formalism through special choices of the expansion functions, but the methods proposed, unlike those methods, do not require the solution of an eigenvalue problem. Numerical calculations, using simple choices for the expansion functions, are carried out for the Reid $^1S_0$ soft-core N–N potential. They show that the convergence of the t-matrix expansion can be very good indeed, especially if it is used in the operator context for which it is designed. (auth)

10434 APPROACH TO ASYMPTOPIA FROM S-CHANNEL DYNAMICS. Ciafaloni, M. (Scuola Normale Superiore, Pisa (Italy)); Marchesini, G. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 55: No. 5, 471-476(17 Mar 1975).

It is suggested that two asymptotic regimes exist in critical point theories of the Pomeron. The single fireball regime of some absorptive models is joined to the strong coupling solution of Reggeon field theory by renormalization group equations. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract 9999.

10435 ANOMALOUS TEMPERATURE DEPENDENCE OF THE POSITIVE ION MOBILITY IN LIQUID ^{3}He. Kuchnir, M. (Universidade Estadual, Campinas, Brazil); Ketterson, J. B.; Roach, P. R. J. Low Temp. Phys.; 19: No. 5/6, 531-535(Jun 1975).

The temperature dependence of the mobility of positive ions in ^{3}H at a pressure of 60 torr has been studied from 0.7 to less than 0.08°K; an unusually sharp peak is observed at approximately 0.2°K. (auth)

10436 A THEORETICAL DESCRIPTION OF THE NEW PHASES OF LIQUID ^{3}He. Leggett, A.J. (School of Mathematical and Physical Sciences, University of Sussex, Falmer Brighton, England). Rev. Mod. Phys. 47: No. 2, 331-414 (Apr 1975).

This paper reviews the theory of anisotropic superfluid phases and its application to the new A and B phases of liquid ^{3}He. It is tutorial in nature and advanced formal techniques are avoided; even the formalism of second quantization is not required. After an initial discussion of the Fermi-liquid theory of Landau and its application to the normal phase of liquid ^{3}He, the idea of instability against formation of Cooper pairs is introduced. The effective interaction in liquid ^{3}He is considered, with emphasis on the spin-dependent interaction arising from virtual spin polarization of the medium ("spin fluctuation exchange"). Next, a self-contained discussion of the "weak-coupling" BCS theory as applied to anisotropic superfluids is given, with special attention to the "Ginzburg–Landau" region close to the transition temperature. Formulas are derived for the specific heat, spin susceptibility, normal density tensor, and static spin-dependent correlation properties of superfluids with both singlet and triplet pairing: In the triplet case the ideas of "spin superfluid velocity" and "spin superfluid density" are also introduced. After a preliminary comparison of the weak-coupling theory with experiment, it is shown that feedback effects due to the modification, by formation of Cooper pairs, of the effective interaction connected with spin fluctuation exchange can produce results which are qualitatively different from those of the weak-coupling theory. An attempt is made to reformulate recent graph-theoretical treatments of this phenomenon in a more elementary language, and considerations based on possible invariant forms of the free energy are also introduced. The properties of the so-called Anderson–Brinkman–Morel and Balian–Werthamer states, which are commonly identified with ^{3}He–A and B, respectively, are studied in detail. Next, the effects which tend to orient the Cooper pair wave function in a given experimental situation are discussed; in this context the form of the free energy terms arising from spatial variation of the wave function is explored. A semiphenomenological theory of the nuclear magnetic resonance properties is developed and applied in particular to the case of unsaturated cw resonance; the analogy with the Josephson effect is emphasized. The question of relaxation and linewidths is also briefly discussed. A partial account is given of the theory of finite-wavelength collective oscillations, with particular reference to first, second, and fourth sound and spin waves. The splitting of the A-normal transition in a magnetic field is considered, with special attention to the possibility it offers of testing theories of the "spin fluctuation" type. Finally, a brief assessment is made of the extent to which the current experimental data support the conventional identification of ^{3}He–A and B and the spin fluctuation theory, and some outstanding problems and possibilities are outlined. Subjects not discussed include "first-principles" theories of the effective interaction in ^{3}He, collective excitations in the "collisionless" regime, and the problem of ultrasonic absorption, "orbit waves," and the theory of the kinetic coefficients. (auth)

10437 EXPERIMENTAL PROPERTIES OF SUPERFLUID ^{3}He. Wheatley, J.C. (Department of Physics, University of California at San Diego, La Jolla, California 92037). Rev. Mod. Phys. 47: No. 2, 415-470 (Apr 1975).

This paper presents a summary and evaluation of the experimental properties of superfluid ^{3}He as they were known in the fall of 1974. Subjects having thermodynamic significance, including specific heat, static magnetism, phase equilibria, and superfluid density, are discussed first. Then known flow properties are treated. After a brief discussion of the theoretical ideas which motivated some of the later experiments, the subject of dynamic magnetism is reviewed. Closely related work in a magnetic field in the immediate temperature region of the critical temperature is discussed, as are the propagation of ultrasound, the phenomena of supercooling and superheating, precise indication of the critical temperature, and the effects of certain restrictive geometries. The article concludes with a brief discussion of some new developments which appeared after the main text was finished. Appendices on thermometry and on parameters of the normal Fermi liquid are included. (auth)

10438 DERIVATION OF THE TWO-FLUID MODEL FOR BOSE-CONDENSED EXCITONS. Haug, H. (Institut für Struktur der Materie der Universität Karlsruhe, 75 Karlsruhe, Federal Republic of Germany); Hanamura, E. Phys. Rev. B 11: No. 9, 3317-3328 (1 May 1975).

The second reduced electron-hole density matrix is shown to have the property of off-diagonal long-range order for a Bose-condensed system of Wannier excitons. From the equations of motion for this density matrix the conservation laws for the density, the particle current density, and the energy density of the excitons are derived, as well as the equation of motion for the velocity of the condensate. These equations are obtained by projecting the electron-hole density matrices into the exciton space. From the above-mentioned conservation laws the two-fluid model is deduced, which describes the superfluid flow of excitation energy. In the low-density limit all hydrodynamical quantities are calculated explicitly. Extensions to the case of condensation in the presence of static homogeneous electromagnetic fields and to the case of indirect semiconductors are given. (auth)

10439 EXPERIMENTS ON THE SUPERFLUID CIRCULATION IN ROTATING HELIUM II. Kral, S.F.; Zimmermann, W. Jr. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota). Phys. Rev. B 11: No. 9, 3334-3347 (1 May 1975).

Experimental observations have been made of the magnitude and direction of the superfluid circulation around a fine wire in a rotating vessel filled with He II, by means of the Vinen method. Measurements were made using wires from 66 to 83 μm in diameter at temperatures from 1.23 to 1.35°K with angular velocities of rotation in the range between ± 4 rad sec^{-1}. At any given rotational angular velocity, the circulation was observed to be metastable over a continuous range of values between certain limits which lay several quantum units apart and which varied with angular velocity. Direct evidence for quantization of circulation is lacking in these observations as a result of the metastability encountered. However, the general trend of the metastable values of circulation as a function of rotational angular velocity is in accord with the predictions of simple minimum-free-energy arguments for the dependence of the true equilibrium value of circulation upon angular velocity. (auth)

10440 EXACTLY SOLVABLE MODEL FOR TRICRITICAL PHENOMENA. Emery, V.J. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. B 11: No. 9, 3397-3405 (1 May 1975).

An n-component continuous-spin model with a tricritical point is solved exactly in the limit $n \to \infty$. Its properties are derived and are compared with the results of experiments and approximate calculations. The model leads to an analytical description of the features of tricritical points and suggests the use of an approximation procedure for discrete spin systems which is a substantial qualitative and quantitative improvement on mean-field theory. (auth)

10441 ESTIMATE OF INTEGRATED s-WAVE RAMAN SCATTERING INTENSITY FROM THE $2\,^1P_1$ ULTRAVIOLET ABSORPTION LINE SHAPE IN LIQUID HELIUM. Kleban, P.; Halley, J.W. (Department of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. B 11: No. 9, 3520-3534 (1 May 1975).

We show in a unified model that the shift and width of the ultraviolet absorption line shapes in liquid helium are related to the integrated Raman-scattering cross sections. This relation is used to estimate the magnitude of the integrated s-wave scattering by use of the observed ultraviolet spectrum. We find $0.25 \lesssim I_s/I_d \lesssim 3.4$. The model gives standard results for d-wave scattering. We discuss some other possible uses of the model. (auth)

10442 DIRECTION OF PAIRED SPINS IN THE A_1 PHASE OF ^{3}He: A TEST OF THE PARAMAGNON-INDUCED-PAIRING HYPOTHESIS. Levin, K. (Physics Department, University of California, Irvine, California 92664). Phys. Rev. Lett. 34: No. 16, 1002-1005 (21 Apr 1975).

It is shown within the contex of simple paramagnon theory that, if spin fluctuations are responsible for the pairing in superfluid ^{3}He, then the direction of paired spins in the A_1 phase should be opposite to that of the field-induced magnetization in the normal state, in contradiction to predictions made using weak-coupling theory. Measurements of the direction of paired spins in the A_1 phase can thus help to test the paramagnon-pairing hypothesis. (auth)

10443 TRICRITICAL SLOWING DOWN OF SUPERFLUID DYNAMICS IN ^{3}He-^{4}He MIXTURES. Leiderer, P.; Nelson, D.R.; Watts, D.R.; Webb, W.W. (School of Applied and Engineering Physics, Laboratory of Atomic and Solid State Physics, Baker Laboratory). Phys. Rev. Lett. 34: No. 17, 1080–1083 (28 Apr 1975).

Measurements of the Rayleigh scattering by concentration fluctuations in the coexisting superfluid in ^{3}He-^{4}He mixtures near the tricritical

temperature T_t show a single Lorentzian line of width such that $\Gamma/q^2 = D_{\text{eff}} = 1.5 \times 10^{-4} \epsilon^{0.95 \pm 0.07}$ cm^2 sec^{-1} for $9 \times 10^{-4} \leq 1 - T/T_t \equiv \epsilon \leq 7 \times 10^{-3}$. Thus the effective diffusion coefficient D_{eff} is proportional to ϵ^{+1} and, since the concentration susceptibility $(\partial x/\partial \Delta)_{PT}$ is proportional to ϵ^{-1}, the effective kinetic coefficient $L_{D,\text{eff}} = D_{\text{eff}}/(\partial \Delta/\partial x)_{PT}$ is proportional to $\epsilon^{+1}\epsilon^{-1} \sim \epsilon^0$. (auth)

Superconductivity

Refer also to abstracts 9341, 9399, 9422–9423, 9431–9434, 9449, 9453, 9460, 9463–9464, 9504, 9509–9511, 9517, 9534–9535, 9537, 9539, 9605, 9617, and 10009.

10444 VARIATIONAL CALCULATION OF THE MAGNETIC PROPERTIES OF TYPE-II SUPERCONDUCTORS IN THE MIXED STATE. Khanra, B. C.; Raychaudhuri, A. K. (Saha Inst. of Nuclear Physics, Calcutta). pp 14-16 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27–31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

10445 EFFECT OF AN EDGE BARRIER ON THE CRITICAL CURRENT OF SUPERCONDUCTING FILMS. Kupriyanov, M.Yu.; Likharev, K.K. (M. V. Lomonosov Moscow State University). Sov. Phys.—Solid State 16: No. 10, 1835-1837 (Apr 1975).

The effect of inhomogeneity at the edges of a superconducting film on its critical current is treated theoretically. The calculations are carried out for broad ($w > \delta_\perp$) superconducting films without bulk inhomogeneities. It is assumed here that the fluxoids in such a film only enter when the flux density at the edge reaches a critical value. The distributions of fluxoid density and current density over the width of the film are calculated under these assumptions along with the dependence of the critical current I_c on the component of the magnetic field H perpendicular to the film surface. A comparison of the calculated relation $I_c(H)$ with experimental data has shown that in real films in the absence of a magnetic field $I_c(0)$ agrees in order of magnitude with the values determined experimentally. However, the slope $(dI_c/dH)_{H=0}$ of the experimentally observed dependence turns out to be two or three orders of magnitude less than the calculated value $(dI_c/dH)_{H=0} = w/4$. This shows that the relation $I_c(H)$ in ordinary films is almost totally determined by bulk pinning of the fluxoids. (auth)

10446 THERMAL CONDUCTIVITY OF SUPERCONDUCTING ALLOYS WITH NONMAGNETIC LOCALIZED STATES. Kon, L.Z.; Moskalenko, A.A. (Institute of Applied Physics, Academy of Sciences of the Moldavian SSR, Kishinev). Sov. Phys.—Solid State 16: No. 10, 1877-1878 (Apr 1975).

The thermal conductivity of superconducting alloys is calculated on the basis of the Anderson Hamiltonian for the Bardeen-Schrieffer-Cooper interaction. Nonmagnetic localized impurity states are considered. (auth)

10447 FLUCTUATION SUPERCONDUCTIVITY AT HIGH MAGNETIC FIELDS. Lue, J.W.; Montgomery, A.G.; Hake, R.R. (Indiana University, Bloomington, Indiana 47401). Phys. Rev. B 11: No. 9, 3393-3396 (1 May 1975).

Apparent superconductive fluctuation conductivity ("paraconductivity") $\Delta\sigma_f$ has been observed in very "dirty" (short electron-mean-free-path), bulk, type-II superconductors in applied magnetic fields H up to twice the zero-temperature upper critical field H_{c20}. Peaks observed in the isomagnetic field paraconductivity as a function of temperature at $H > H_{c20}$ are attributed to the suppression of paraconductivity as T approaches either zero or values high in comparison with the zero-H transition temperature T_c. In the (H-T) region well beyond the upper-critical-field curve $H_{c2}(T)$, the experimentally derived $\Delta\sigma_f(H, T)$ is smaller, less dependent on the orientation of H with respect to the measuring current density J, and decreases more rapidly with H than suggested by current theory. As H is increased isothermally in the 80–140-kG region, the positive magnetoresistance associated with the H quenching of paraconductivity gives way to a small negative magnetoresistance which is probably not explicable on an ordinary static-localized-magnetic-moment basis. (auth)

10448 STUDY OF THE POSSIBLE EFFECTS OF DEFECTS IN A SOFT LATTICE. Chui, S.T. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 11: No. 9, 3457-3460 (1 May 1975).

To understand a phonon kink in the (110) LA phonon dispersion near $q \sim$ (0.09, 0.09, 0) q_{ZB} in Nb_3Sn discovered recently by Axe and Shirane, a computer calculation has been done on a model of vacancies in a soft lattice. The model consists of a two-dimensional square lattice with a vacancy concentration of 1% arranged periodically. The interatomic forces are arranged so that part of the phonon modes of the perfect lattice are unstable. The atoms around the vacancies are allowed to relax and the phonon frequencies of the resulting system are calculated. We found that (i) the distortion around the vacancy can break the symmetry of the crystal, and (ii) the small-q portion of the phonon spectrum consists of two flat portions with different slopes joined smoothly to each other. (auth)

10449 ANISOTROPIC THERMAL EFFECT IN SUPERCONDUCTORS. Kresin, V.Z.; Litovchenko, V.A. (Moscow Pedagogical Extension Institute). JETP Lett. 21: No. 1, 19-20 (5 Jan 1975).

An expression is obtained for the field produced in the anisotropic thermal effect (ATE) in superconductors. It becomes possible to observe the ATE in highly purified samples, in which the principal role is played by the relaxation mechanism; this agrees with recent measurements. (auth)

PHYSICS (NUCLEAR)

10450 RESOURCE LETTER MENP-1: MEDIUM ENERGY NUCLEAR PHYSICS. Sternheim, M.M. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002); Koch, J.H. Am. J. Phys. 43: No. 6, 475-481 (June 1975).

Prepared at the request of the AAPT Editorial Board for Resource Letters. This is one of a series of Resource Letters on different topics intended to guide college physicists, astronomers, and other scientists to some of the literature and other teaching aids that may help improve course contents in specified fields. No Resource Letter is meant to be exhaustive and complete; in time there may be more than one letter on some of the main subjects of interest. Comments on these materials as well as suggestions for future topics will be welcomed. Please send such communications to Professor Aaron Owens, Editor, Resource Letter Board, Department of Physics, Lake Forest College, Lake Forest, Illinois 60045. Notation: The letter E after an item number indicates elementary level; the letter I indicates intermediate level; and the letter A indicates advanced material. An asterisk (*) indicates those references we feel to be especially helpful. Reprints: When ordering, request Resource Letter MENP-1. Enclose 50 cents per copy (not in stamps) together with a stamped and self-addressed envelope and send to Arnold A. Strassenburg, Executive Officer, American Association of Physics Teachers, Graduate Physics Building, SUNY at Stony Brook, Stony Brook, New York 11794. (auth)

Neutron Interactions with Matter

Refer also to abstracts 9619, 9712, 10010, 10489, 10565, 11076, and 11078.

10451 (JUL-1110-MA) GALERKIN METHOD FOR THE DIFFUSION EQUATION WITH DRIFT TERM. Profant, M. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Angewandte Mathematik). Sep 1974. 39p. (In German). INIS.

The stationary diffusion equation with drift term, an elliptical differential equation, is studied and a solution outside the unit sphere is wanted. With the help of computer programs this three-dimensional problem with mixed boundary conditions is numerically solved. (GE)

10452 (MHSMP-75-10) THERMAL NEUTRON ATTENUATION AND ABSORPTION. Carter, J. W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). May 1975. 40p. Dep. NTIS $5.00.

Thesis.

Gold activation techniques have been used to determine the flux reduction of thermal neutrons by various materials. It was found that the half-value layer of the materials investigated is: (1) Adiprene, a polyurethane, –0.36", (2) Steel –0.531", (3) Aluminum –1.39" and (4) Lead –1.55". Conversions to the flux reduction as a function of linear mass of the attenuators have been made. Some general recommendations for the design of neutron shields result from the measurements. (8 figures, 5 tables) (auth)

10453 (WANL-TMI-1161) MODIFICATION OF GAM-I. Stevens, C. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Jul 1964. 5p. Dep. NTIS $4.00.

The GAM and GAM-TNS program have been altered slightly in order to permit the reading in, on cards, of a flux to use for cross section averaging. In addition to the choice of sources now available for computing a spectrum, one can now also read in a source. Directions for using GAM are given. These modified instructions are also applicable to users of GAM-TNS. (auth)

10454 QUASI-ELASTIC SCATTERING OF NEUTRONS IN WATER. Bansal, R. M.; Tewari, S. P. (Univ. of Delhi). pp 238-240 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27–31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

10455 NEUTRON TRANSPORT AND DIFFUSION IN INHOMOGENEOUS MEDIA. I. Larsen, E.W. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). J. Math. Phys. (N.Y.) 16: No. 7, 1421-1427 (July 1975).

The asymptotic solution of the neutron transport equation is obtained for large near-critical domains D which possess a cellular, nearly periodic structure. A typical mean free path in D is taken to be of the same order of magnitude as a cell diameter, and these are taken to be small (of order ϵ) compared to a typical diameter of D. The solution is asymptotic with respect to the small parameter ϵ. It is a product of two functions, one determined by a detailed cell calculation and the other obtained as the solution of a time dependent diffusion equation. The diffusion equation contains precursor (delayed neutron) densities, equations for which are derived. The coefficients in the diffusion equation, which are determined using the results of the cell calculation, differ from those now used in engineering applications. The initial condition for the diffusion equation is derived, and the problem of determining the boundary condition is discussed. (auth)

10456 THEORY OF TRANSVERSE NEUTRON INELASTIC SCATTERING IN THE TRANSITION METALS. Kuzemsky, A. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Phys. Condens. Matter; 18: No. 3, 179-187 (Nov 1974).

A qualitative analysis of the transverse neutron inelastic cross section for the Hubbard model with s-d hybridization in the framework of RPA is considered. The poles of the transverse generalized spin susceptibility are studied. It is found that the acoustic spin wave pole exists among the set of poles of dynamical spin susceptibility and that the noninteracting susceptibility determines the four quasi-Stoner continuum. (auth)

10457 SOLUTIONS OF DIFFUSION EQUATIONS BY FOURIER EXPANSIONS. Ohtani, N.; Jung, J.; Kobayashi, K.; Nishihara, H. (Kyoto Univ.). Ann. Nucl. Sci. Eng.; 1: No. 11/12, 547-553(Nov 1974).

One and two-dimensional diffusion equations in slab geometry are solved by a method of Fourier expansion. In this method equations for the fluxes on the boundaries and their normal derivatives are derived. Applying boundary conditions, these equations are solved and all boundary values are determined. Using these boundary values, the Fourier coefficients of the flux in the region are calculated. Unlike the eigenfunction expansion method, the function series used for the expansion is independent of the boundary conditions, therefore multi-regional problems are also solved. The results of the numerical calculations are given and compared with the results by the usual finite difference method. (auth)

10458 EFFECT OF NEUTRON ENERGY DEPENDENCE AND ANISOTROPIC SCATTERING ON THE LINEAR EXTRAPOLATION DISTANCE OF A BLACK SPHERE. I. General Theory. Williams, M. M. R. (Queen Mary Coll., London). J. Phys., D (London); 7: No. 16, 2174-2187(1 Nov 1974).

A detailed mathematical examination has been made of the effect of the neutron energy spectrum and scattering anisotropy on the linear extrapolation distance of a black sphere embedded in an infinite, nonabsorbing moderator. The integro-differential form of the Boltzmann transport equation has been reduced to a set of coupled integral equations for the spherical harmonic moments of the flux, and a variational functional has been found for the linear extrapolation distance and net current into the sphere for an arbitrary scattering law. The form of the asymptotic solution in the moderator has been obtained, and its implications as a trial function for the variational method are discussed. A simple trial function is used to study the dependence of the extrapolation distance on the energy variation of the scattering cross section, and significant deviations from one-speed theory are noted. In the case of scattering anisotropy, it is demonstrated that curved geometries are more sensitive to the higher angular moments of the scattering kernel, particularly when the sphere radius is of the order of a mean free path of a neutron in the moderator. Finally, some limitations of simple trial functions for spherical systems are pointed out and ways of introducing improvements are suggested. (auth)

10459 PULSED NEUTRON STUDIES IN WATER POISONED WITH NON $1/v$ ABSORBERS. Bansal, R. M.; Tewari, S. P.; Kothari, L. S. (Univ. of Delhi). J. Phys., D (London); 8: No. 6, 620-628(21 Apr 1975).

Thermalization parameters for water poisoned with non-$1/v$ absorbers, Cd, Gd and Sm, have been calculated using the neutron scattering kernel recently proposed by the authors. Calculated values of the parameters are compared with the available experimental data and with values based on other scattering kernels. For the first time a reasonable agreement between the theoretical and recent experimental results is obtained. Time-dependent spectra in infinite assemblies have also been calculated and reaction rates as functions of time have been computed. These are in close agreement with the measurements of Fujino et al. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 9619, 10349, 10359, and 10369.

10460 (CERN-74-8, pp 63-91) RADIATIVE PION CAPTURE. Truoel, P. 10 Apr 1974.

From topical meeting on intermediate energy physics; Zuoz, Switzerland (4 Apr 1973).

In topical meeting on intermediate energy physics, Lyceum Alpinum, Zuoz, Engadin, Switzerland, 4–13 April 1973. Proceedings. (Schweizerisches Inst. fuer Nuklearforschung, Villigen; European Organization for Nuclear Research, Geneva (Switzerland)).

The theory of radiative pion capture in nuclei is briefly outlined, together with experimental data for ^{1}H, ^{2}H, ^{3}He and ^{4}He targets. A more detailed comparison of theory and experiment is given for the reaction with ^{6}Li. Suggestions are made for further experiments, particularly coincidence measurements made possible by the new higher intensity accelerators. (auth)

10461 STUDY OF THE FIVE NUCLEON SYSTEM WITH THE NUCLEAR REACTIONS $^{3}He(d,p)^{4}He$ AND $^{3}He(\vec{d},p)^{4}He$ IN THE ENERGY RANGE E_d 300–1,150 keV. Forssmann, B. Mainz; Univ. Mainz (1972). 28p. (In German). INIS.

Thesis.

The differential cross section and the vector polarization sensitivity of the $^{3}He(d,p)^{4}He$ reaction were measured at 18 energies between 320 and 1,150 keV. To control the measurement of the vector polarization sensitivity on apparative asymmetries the proton angular distribution was measured as well as the alpha particles for the left-right asymmetry at 8 angles. An analysis after Legendre polynomials was made in the least square fit method. (auth)

10462 A MICROSCOPE OPTICAL POTENTIAL FOR ^{3}He. Sinha, B.; Duggan, F.; Griffiths, R. J. (King's Coll., London (UK). Wheatstone Physics Lab.). Nucl. Phys., A; 241: No. 2, 229-236(7 Apr 1975).

A three-parameter optical model for ^{3}He was developed in terms of the optical potentials of its constituent nucleons. An effective interaction folding model including exchange is used to generate the real part, whereas the imaginary part is calculated using a forward-scattering amplitude approximation. The spin-orbit potential is calculated using the Blin-Stoyle prescription. This model reproduces the experimental data reasonably well. (auth)

10463 RADIATIVE PION CAPTURE IN LIGHT NUCLEI. Truoel, P. (Zurich Univ. (Switzerland)); Baer, H. W.; Bistirlich, J. A.; Crowe, K. M.; de Botton, N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 247-253 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

New results from a high resolution measurement of the photon spectra following radiative pion capture in ^{3}He, ^{6}Li and ^{14}N are presented. The observed branching ratios to bound states are compared with theoretical calculations based on the impulse approximation. For the 1p-shell nuclei excellent agreement is obtained, when shell model wave functions and a Hamiltonian deduced from the fundamental process $\pi^{-}p \rightarrow n\gamma$ are used. For the $^{6}Li(\pi^{-},\gamma)^{6}He(0^{+})$ and the $^{3}He(\pi^{-},\gamma)^{3}H$ transitions test predictions are presented using PCAC and soft-pion techniques, which are especially relevant in comparison to the experimentally observed Panofsky-ratio in ^{3}He. Transitions to higher excited states in the giant resonance region and into the continuum are also discussed. (auth)

10464 π^{+} AND π^{-} TOTAL CROSS SECTIONS FOR ^{6}Li, ^{7}Li, ^{9}Be, C AND O FROM 90 TO 860 MeV. Clough, A. S.; Turner, G. K. (Surrey Univ., Guildford (UK). Dept. of Physics); Allardyce, B. W.; Batty, C. J.; Baugh, D. J.; McDonald, W. J.; Riddle, R. A. J.; Watson, L. H.; Cage, M. E.; Pyle, G. J. pp 213-218 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Total cross sections for $\pi^{\pm}$ mesons were measured for ^{6}Li, ^{7}Li, ^{9}Be, and C from 90 to 860 MeV and for O from 90 to 230 MeV. Coulomb corrections to the data are discussed together with the effects of the distortion of the pion wave function by the Coulomb field. The results are analyzed using dispersion relations to give values of the real part of the forward scattering amplitude and the effective pion-nucleus coupling constant. The results are also compared with predictions from the optical model. (auth)

10465 THE REACTION $d(p,\pi^{+})t$. Perdrisat, C. F.; Dollhopf, W.; Lunke, C. (College of William and Mary, Williamsburg, Va. (USA)); Roberts, W. K. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center); Kitching, P.; Olsen, W. C. (Alberta Univ., Edmonton (Canada). Nuclear Research Centre); Priest, J. R. (Miami Univ., Oxford, Ohio (USA)). pp 285-288 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The differential cross section for the reaction $d(p,\pi^{+})t$ was measured for cm angles between 37 and 160 degrees, at incident proton energies of 470 and 590 MeV. The results are in qualitative agreement with the prediction of a model of the reaction assuming that it is a two-nucleon process, but for the existence of a backward peak at 470 MeV. No satisfactory explanation of this backward peak is forthcoming, although it is noted that a similar peak exists in previously published data. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 8449, 10097, 10160, 10498, 10511, and 10539.

10466 (ITEP-55) EXCITATION OF ^{16}O LEVELS BY HIGH-ENERGY PROTONS. Goryachev, Yu. M.; Kanavets, V. P.; Kirpichnikov, I. V.; Levintov, I. I.; Morozov, B. V.; Nikiforov, N. A.; Starostin, A. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 16p. INIS.

The spectra of γ - rays produced in ^{16}O by 1.0, 2.9 and 6.3 GeV protons were measured with a Ge(Li) γ-spectrometer. (auth)

10467 (ORO-4856-11) STUDY OF (p,2p) REACTION ON LIGHT NUCLEI. Bhowmik, R. K. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1 Oct 1974. 162p. Dep. NTIS $11.25.

Thesis.

The (p,2p) reactions on the target nuclei ^{6}Li, ^{7}Li and ^{12}C have been studied at 100 MeV bombarding energy using the University of Maryland Sectored Isochronous Cyclotron. The energies of both the outgoing protons have been measured in coincidence in a coplanar symmetric geometry to obtain the energy and angular correlation between the detected protons. Care has been taken to obtain good energy and momentum resolution in order to separate the different excited states of the residual nuclei. The experimental data are presented in a form suitable for direct comparison with theory. In the case of $^{6}Li(p,2p)^{5}He$ reaction leading to the 'ground state' region of the residual nucleus, a cluster model description of ^{6}Li and a scattering state approximation of the residual nucleus can explain most of the features of the experimental data. In the case of ^{7}Li and ^{12}C, the DWIA model can qualitatively explain the change in shape of the momentum distributions for the ground states of the residual nuclei extracted from the energy sharing spectra at different angle pairs. The detailed quantitative agreement with DWIA is however somewhat poor indicating the necessity of a more exact treatment of three body effects. The knockout of the 1s proton is observed for all three nuclei studied. The cross section becomes progressively weaker in going from ^{6}Li to ^{12}C. (41 figures, 11 tables, 75 references) (auth)

10468 GROUND STATE ROTATIONAL BANDS IN ^{16}O, ^{40}Ca, AND ^{208}Pb. Lezuo, K. (Mainz Univ. (F. R. Germany). Inst. fuer Kernphysik). Z. Naturforsch., A; 30: No. 2, 158-160(Feb 1975).

It is pointed out that a considerable amount of evidence exists to support the concept of a ground state rotational band based on tetrahedral deformation for ^{16}O, ^{40}Ca and ^{208}Pb. The possible meaning of this interpretation as well as other well known alternatives are discussed. (auth)

10469 A MEASUREMENT OF THE TOTAL FAST NEUTRON CROSS SECTION OF ^{27}Al BY USE OF SILICON SOLID STATE DETECTORS. Waymire, D. R.; Ilgen, K. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Strahlenphysik). Z. Phys., A.; 272: No. 1, 107-111(1975). (In German).

The total fast neutron cross section of ^{27}Al was determined by transmission measurements using Si(Li)-solid state detectors for neutron spectroscopy. The energies of the bombarding neutrons were in the range between 5.24 and 7.26 MeV. A comparison was made between the total cross sections obtained in this experiment and values obtained via the time-of-flight technique. At most neutron energies the agreement was within experimental errors quoted for the works being compared. (auth)

PHYSICS (NUCLEAR)

10450 RESOURCE LETTER MENP-1: MEDIUM ENERGY NUCLEAR PHYSICS. Sternheim, M.M. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002); Koch, J.H. Am. J. Phys. 43: No. 6, 475-481 (June 1975).

Prepared at the request of the AAPT Editorial Board for Resource Letters. This is one of a series of Resource Letters on different topics intended to guide college physicists, astronomers, and other scientists to some of the literature and other teaching aids that may help improve course contents in specified fields. No Resource Letter is meant to be exhaustive and complete; in time there may be more than one letter on some of the main subjects of interest. Comments on these materials as well as suggestions for future topics will be welcomed. Please send such communications to Professor Aaron Owens, Editor, Resource Letter Board, Department of Physics, Lake Forest College, Lake Forest, Illinois 60045. Notation: The letter E after an item number indicates elementary level; the letter I indicates intermediate level; and the letter A indicates advanced material. An asterisk (*) indicates those references we feel to be especially helpful. Reprints: When ordering, request Resource Letter MENP-1. Enclose 50 cents per copy (not in stamps) together with a stamped and self-addressed envelope and send to Arnold A. Strassenburg, Executive Officer, American Association of Physics Teachers, Graduate Physics Building, SUNY at Stony Brook, Stony Brook, New York 11794. (auth)

Neutron Interactions with Matter

Refer also to abstracts 9619, 9712, 10010, 10489, 10565, 11076, and 11078.

10451 (JUL-1110-MA) GALERKIN METHOD FOR THE DIFFUSION EQUATION WITH DRIFT TERM. Profant, M. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Angewandte Mathematik). Sep 1974. 39p. (In German). INIS.

The stationary diffusion equation with drift term, an elliptical differential equation, is studied and a solution outside the unit sphere is wanted. With the help of computer programs this three-dimensional problem with mixed boundary conditions is numerically solved. (GE)

10452 (MHSMP-75-10) THERMAL NEUTRON ATTENUATION AND ABSORPTION. Carter, J. W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). May 1975. 40p. Dep. NTIS $5.00.

Thesis.

Gold activation techniques have been used to determine the flux reduction of thermal neutrons by various materials. It was found that the half-value layer of the materials investigated is: (1) Adiprene, a polyurethane, –0.36", (2) Steel –0.531", (3) Aluminum –1.39" and (4) Lead –1.55". Conversions to the flux reduction as a function of linear mass of the attenuators have been made. Some general recommendations for the design of neutron shields result from the measurements. (8 figures, 5 tables) (auth)

10453 (WANL-TMI-1161) MODIFICATION OF GAM-I. Stevens, C. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Jul 1964. 5p. Dep. NTIS $4.00.

The GAM and GAM-TNS program have been altered slightly in order to permit the reading in, on cards, of a flux to use for cross section averaging. In addition to the choice of sources now available for computing a spectrum, one can now also read in a source. Directions for using GAM are given. These modified instructions are also applicable to users of GAM-TNS. (auth)

10454 QUASI-ELASTIC SCATTERING OF NEUTRONS IN WATER. Bansal, R. M.; Tewari, S. P. (Univ. of Delhi). pp 238-240 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, India, December 27–31, 1973. Vol. 16 C. Bombay; Dept. of Atomic Energy (1973).

From proceedings of the nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). See CONF-731229-P16C.

10455 NEUTRON TRANSPORT AND DIFFUSION IN INHOMOGENEOUS MEDIA. I. Larsen, E.W. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). J. Math. Phys. (N.Y.) 16: No. 7, 1421-1427 (July 1975).

The asymptotic solution of the neutron transport equation is obtained for large near-critical domains D which possess a cellular, nearly periodic structure. A typical mean free path in D is taken to be of the same order of magnitude as a cell diameter, and these are taken to be small (of order ϵ) compared to a typical diameter of D. The solution is asymptotic with respect to the small parameter ϵ. It is a product of two functions, one determined by a detailed cell calculation and the other obtained as the solution of a time dependent diffusion equation. The diffusion equation contains precursor (delayed neutron) densities, equations for which are derived. The coefficients in the diffusion equation, which are determined using the results of the cell calculation, differ from those now used in engineering applications. The initial condition for the diffusion equation is derived, and the problem of determining the boundary condition is discussed. (auth)

10456 THEORY OF TRANSVERSE NEUTRON INELASTIC SCATTERING IN THE TRANSITION METALS. Kuzemsky, A. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Phys. Condens. Matter; 18: No. 3, 179-187 (Nov 1974).

A qualitative analysis of the transverse neutron inelastic cross section for the Hubbard model with s-d hybridization in the framework of RPA is considered. The poles of the transverse generalized spin susceptibility are studied. It is found that the acoustic spin wave pole exists among the set of poles of dynamical spin susceptibility and that the noninteracting susceptibility determines the four quasi-Stoner continuum. (auth)

10457 SOLUTIONS OF DIFFUSION EQUATIONS BY FOURIER EXPANSIONS. Ohtani, N.; Jung, J.; Kobayashi, K.; Nishihara, H. (Kyoto Univ.). Ann. Nucl. Sci. Eng.; 1: No. 11/12, 547-553(Nov 1974).

One and two-dimensional diffusion equations in slab geometry are solved by a method of Fourier expansion. In this method equations for the fluxes on the boundaries and their normal derivatives are derived. Applying boundary conditions, these equations are solved and all boundary values are determined. Using these boundary values, the Fourier coefficients of the flux in the region are calculated. Unlike the eigenfunction expansion method, the function series used for the expansion is independent of the boundary conditions, therefore multi-regional problems are also solved. The results of the numerical calculations are given and compared with the results by the usual finite difference method. (auth)

10458 EFFECT OF NEUTRON ENERGY DEPENDENCE AND ANISOTROPIC SCATTERING ON THE LINEAR EXTRAPOLATION DISTANCE OF A BLACK SPHERE. I. General Theory. Williams, M. M. R. (Queen Mary Coll., London). J. Phys., D (London); 7: No. 16, 2174-2187(1 Nov 1974).

A detailed mathematical examination has been made of the effect of the neutron energy spectrum and scattering anisotropy on the linear extrapolation distance of a black sphere embedded in an infinite, nonabsorbing moderator. The integro-differential form of the Boltzmann transport equation has been reduced to a set of coupled integral equations for the spherical harmonic moments of the flux, and a variational functional has been found for the linear extrapolation distance and net current into the sphere for an arbitrary scattering law. The form of the asymptotic solution in the moderator has been obtained, and its implications as a trial function for the variational method are discussed. A simple trial function is used to study the dependence of the extrapolation distance on the energy variation of the scattering cross section, and significant deviations from one-speed theory are noted. In the case of scattering anisotropy, it is demonstrated that curved geometries are more sensitive to the higher angular moments of the scattering kernel, particularly when the sphere radius is of the order of a mean free path of a neutron in the moderator. Finally, some limitations of simple trial functions for spherical systems are pointed out and ways of introducing improvements are suggested. (auth)

10459 PULSED NEUTRON STUDIES IN WATER POISONED WITH NON $1/v$ ABSORBERS. Bansal, R. M.; Tewari, S. P.; Kothari, L. S. (Univ. of Delhi). J. Phys., D (London); 8: No. 6, 620-628(21 Apr 1975).

Thermalization parameters for water poisoned with non-$1/v$ absorbers, Cd, Gd and Sm, have been calculated using the neutron scattering kernel recently proposed by the authors. Calculated values of the parameters are compared with the available experimental data and with values based on other scattering kernels. For the first time a reasonable agreement between the theoretical and recent experimental results is obtained. Time-dependent spectra in infinite assemblies have also been calculated and reaction rates as functions of time have been computed. These are in close agreement with the measurements of Fujino et al. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 9619, 10349, 10359, and 10369.

10460 (CERN-74-8, pp 63-91) RADIATIVE PION CAPTURE. Truoel, P. 10 Apr 1974.

From topical meeting on intermediate energy physics; Zuoz, Switzerland (4 Apr 1973).

In topical meeting on intermediate energy physics, Lyceum Alpinum, Zuoz, Engadin, Switzerland, 4–13 April 1973. Proceedings. (Schweizerisches Inst. fuer Nuklearforschung, Villigen; European Organization for Nuclear Research, Geneva (Switzerland)).

The theory of radiative pion capture in nuclei is briefly outlined, together with experimental data for ^{1}H, ^{2}H, ^{3}He and ^{4}He targets. A more detailed comparison of theory and experiment is given for the reaction with ^{6}Li. Suggestions are made for further experiments, particularly coincidence measurements made possible by the new higher intensity accelerators. (auth)

10461 STUDY OF THE FIVE NUCLEON SYSTEM WITH THE NUCLEAR REACTIONS $^{3}He(d,p)^{4}He$ AND $^{3}He(\vec{d},p)^{4}He$ IN THE ENERGY RANGE E_d 300–1,150 keV. Forssmann, B. Mainz; Univ. Mainz (1972). 28p. (In German). INIS.

Thesis.

The differential cross section and the vector polarization sensitivity of the $^{3}He(d,p)^{4}He$ reaction were measured at 18 energies between 320 and 1,150 keV. To control the measurement of the vector polarization sensitivity on apparative asymmetries the proton angular distribution was measured as well as the alpha particles for the left-right asymmetry at 8 angles. An analysis after Legendre polynomials was made in the least square fit method. (auth)

10462 A MICROSCOPE OPTICAL POTENTIAL FOR ^{3}He. Sinha, B.; Duggan, F.; Griffiths, R. J. (King's Coll., London (UK). Wheatstone Physics Lab.). Nucl. Phys., A; 241: No. 2, 229-236(7 Apr 1975).

A three-parameter optical model for ^{3}He was developed in terms of the optical potentials of its constituent nucleons. An effective interaction folding model including exchange is used to generate the real part, whereas the imaginary part is calculated using a forward-scattering amplitude approximation. The spin-orbit potential is calculated using the Blin-Stoyle prescription. This model reproduces the experimental data reasonably well. (auth)

10463 RADIATIVE PION CAPTURE IN LIGHT NUCLEI. Truoel, P. (Zurich Univ. (Switzerland)); Baer, H. W.; Bistirlich, J. A.; Crowe, K. M.; de Botton, N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 247-253 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

New results from a high resolution measurement of the photon spectra following radiative pion capture in ^{3}He, ^{6}Li and ^{14}N are presented. The observed branching ratios to bound states are compared with theoretical calculations based on the impulse approximation. For the 1p-shell nuclei excellent agreement is obtained, when shell model wave functions and a Hamiltonian deduced from the fundamental process $\pi^- p \rightarrow n\gamma$ are used. For the $^{6}Li(\pi^-,\gamma)^{6}He(0^+)$ and the $^{3}He(\pi^-,\gamma)^{3}H$ transitions test predictions are presented using PCAC and soft-pion techniques, which are especially relevant in comparison to the experimentally observed Panofsky-ratio in ^{3}He. Transitions to higher excited states in the giant resonance region and into the continuum are also discussed. (auth)

10464 π^+ AND π^- TOTAL CROSS SECTIONS FOR ^{6}Li, ^{7}Li, ^{9}Be, C AND O FROM 90 TO 860 MeV. Clough, A. S.; Turner, G. K. (Surrey Univ., Guildford (UK). Dept. of Physics); Allardyce, B. W.; Batty, C. J.; Baugh, D. J.; McDonald, W. J.; Riddle, R. A. J.; Watson, L. H.; Cage, M. E.; Pyle, G. J. pp 213-218 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Total cross sections for $\pi^{\pm}$ mesons were measured for ^{6}Li, ^{7}Li, ^{9}Be, and C from 90 to 860 MeV and for O from 90 to 230 MeV. Coulomb corrections to the data are discussed together with the effects of the distortion of the pion wave function by the Coulomb field. The results are analyzed using dispersion relations to give values of the real part of the forward scattering amplitude and the effective pion-nucleus coupling constant. The results are also compared with predictions from the optical model. (auth)

10465 THE REACTION $d(p,\pi^+)t$. Perdrisat, C. F.; Dollhopf, W.; Lunke, C. (College of William and Mary, Williamsburg, Va. (USA)); Roberts, W. K. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center); Kitching, P.; Olsen, W. C. (Alberta Univ., Edmonton (Canada). Nuclear Research Centre); Priest, J. R. (Miami Univ., Oxford, Ohio (USA)). pp 285-288 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The differential cross section for the reaction $d(p,\pi^+)t$ was measured for cm angles between 37 and 160 degrees, at incident proton energies of 470 and 590 MeV. The results are in qualitative agreement with the prediction of a model of the reaction assuming that it is a two-nucleon process, but for the existence of a backward peak at 470 MeV. No satisfactory explanation of this backward peak is forthcoming, although it is noted that a similar peak exists in previously published data. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 8449, 10097, 10160, 10498, 10511, and 10539.

10466 (ITEP-55) EXCITATION OF ^{16}O LEVELS BY HIGH-ENERGY PROTONS. Goryachev, Yu. M.; Kanavets, V. P.; Kirpichnikov, I. V.; Levintov, I. I.; Morozov, B. V.; Nikiforov, N. A.; Starostin, A. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 16p. INIS.

The spectra of γ - rays produced in ^{16}O by 1.0, 2.9 and 6.3 GeV protons were measured with a Ge(Li) γ-spectrometer. (auth)

10467 (ORO-4856-11) STUDY OF (p,2p) REACTION ON LIGHT NUCLEI. Bhowmik, R. K. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1 Oct 1974. 162p. Dep. NTIS $11,25.

Thesis.

The (p,2p) reactions on the target nuclei ^{6}Li, ^{7}Li and ^{12}C have been studied at 100 MeV bombarding energy using the University of Maryland Sectored Isochronous Cyclotron. The energies of both the outgoing protons have been measured in coincidence in a coplanar symmetric geometry to obtain the energy and angular correlation between the detected protons. Care has been taken to obtain good energy and momentum resolution in order to separate the different excited states of the residual nuclei. The experimental data are presented in a form suitable for direct comparison with theory. In the case of $^{6}Li(p,2p)^{5}He$ reaction leading to the 'ground state' region of the residual nucleus, a cluster model description of ^{6}Li and a scattering state approximation of the residual nucleus can explain most of the features of the experimental data. In the case of ^{7}Li and ^{12}C, the DWIA model can qualitatively explain the change in shape of the momentum distributions for the ground states of the residual nuclei extracted from the energy sharing spectra at different angle pairs. The detailed quantitative agreement with DWIA is however somewhat poor indicating the necessity of a more exact treatment of three body effects. The knockout of the 1s proton is observed for all three nuclei studied. The cross section becomes progressively weaker in going from ^{6}Li to ^{12}C. (41 figures, 11 tables, 75 references) (auth)

10468 GROUND STATE ROTATIONAL BANDS IN ^{16}O, ^{40}Ca, AND ^{208}Pb. Lezuo, K. (Mainz Univ. (F. R. Germany). Inst. fuer Kernphysik). Z. Naturforsch., A; 30: No. 2, 158-160(Feb 1975).

It is pointed out that a considerable amount of evidence exists to support the concept of a ground state rotational band based on tetrahedral deformation for ^{16}O, ^{40}Ca and ^{208}Pb. The possible meaning of this interpretation as well as other well known alternatives are discussed. (auth)

10469 A MEASUREMENT OF THE TOTAL FAST NEUTRON CROSS SECTION OF ^{27}Al BY USE OF SILICON SOLID STATE DETECTORS. Waymire, D. R.; Ilgen, K. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Strahlenphysik). Z. Phys., A.; 272: No. 1, 107-111(1975). (In German).

The total fast neutron cross section of ^{27}Al was determined by transmission measurements using Si(Li)-solid state detectors for neutron spectroscopy. The energies of the bombarding neutrons were in the range between 5.24 and 7.26 MeV. A comparison was made between the total cross sections obtained in this experiment and values obtained via the time-of-flight technique. At most neutron energies the agreement was within experimental errors quoted for the works being compared. (auth)

10470 STUDY OF THE (d,^{3}He) REACTION WITH NUCLEI OF THE 1p SHELL. Schwinn, U. Heidelberg; Univ. Heidelberg (1971). 43p. (In German). INIS.

Thesis.

At the external deuteron beam of the Karlsruhe isochronous cyclotron the (d,^{3}He) reactions on target nuclei ^{9}Be, ^{10}B, ^{11}B and ^{13}C were investigated at deuteron energies of 52 MeV. Excited states were found in ^{8}Li, ^{9}Be and ^{12}B. In ^{10}Be the ground state and the levels at E = 3.36 and 5.96 MeV were excited. A new state was found with an excitation energy of 9.60 MeV. The measured angular distributions of transitions to that level show a l = 1 character except the transitions belonging to the 6.50 MeV level in ^{8}Li. (auth)

10471 LITHIUM INDUCED ONE NUCLEON TRANSFER REACTIONS IN NUCLEI OF THE 1p AND 2s1d SHELL. Schumacher, P. E. Heidelberg; Univ. Heidelberg (1971). 63p. (In German). INIS.

Thesis.

For the study of one-nucleon transfer reactions on nuclei of the 1p and 2s1d shell angular distributions of the stripping reactions (^{7}Li,^{6}Li) and (^{7}Li,^{6}He) on ^{12}C, ^{13}C, ^{16}O and ^{28}Si were measured as well as angular distributions of the pickup reactions (^{6}Li,^{7}Li) and (^{7}Li,^{8}Li) on ^{13}C at 34 and 36 MeV. The angular distributions decreasing sharply with the reaction angle show a relatively low structure and have a forward cross section up to 10 mb/sr. The neutron transfer (^{7}Li,^{6}Li) exceeds the proton transfer (^{7}Li,^{6}He) by a factor 5 in the cross section. The elastic and inelastic scattering was measured simultaneous with the transfer reactions and allowed to determine the optical model parameters for the dwba-calculations. The angular distributions of the transfer reactions were investigated with the help of a finite-range dwba-analysis. (auth)

10472 ABSORPTION OF SLOW NEUTRONS IN ^{22}Na, ^{26}Al, ^{36}Cl, ^{48}V, ^{52}Mn, ^{56}Co, AND THE NEUTRON THRESHOLD EFFECT ON THE REACTIONS ^{19}F(α,n), (α,p), (α,$\alpha_1\gamma$) AND ^{22}Ne(p,n), (p,$p_1\gamma$). Ehehalt, R. Munich; Technische Univ. (1972). 55p. (In German). INIS.

Thesis.

Cross sections of reactions are examined which, after the capture of a slow neutron, proceed over the emission of charged particles. As a result of the discussion of the Q-values, it could be seen that suitable nuclei especially in the region of small masses and beta$^+$ instable nuclei are to be found. Also an analysis of the resonance structure of ^{23}Na in the region of the neutron threshold is described. (auth)

10473 DECAY RATIOS OF N-12 AND B-12 TO THE FIRST EXCITED STATE OF C-12. Spoden, W. Heidelberg; Univ. Heidelberg (1973). 38p. (In German). INIS.

Thesis.

In the systematics of the ft-values of mirror decays, there is a notable exception: the decay of B^{12}, N^{12} to the first excited carbon level. Measurements by Peterson and Glas gave surprisingly a negative value of -0.13 ± 0.07 for the asymmetry parameter. The branching ratio of the decays of N-12 and B-12 are newly determined. The asymmetry parameter resulting from this experiment is $+0.01 \pm 0.02$. (auth)

10474 LIMIT ON PARITY NONCONSERVATION IN *p*-NUCLEUS SCATTERING AT 6 GeV/c. Bowman, J.D.; Hoffman, C.M.; Hwang, C.F.; Mischke, R.E.; Nagle, D.E.; Potter, J.M. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544); Alde, D.M.; Debrunner, P.G.; Frauenfelder, H.; Sorensen, L.B.; Anderson, H.L.; Talaga, R. Phys. Rev. Lett. 34: No. 18, 1184-1186 (5 May 1975).

We measure a limit on a parity-nonconserving asymmetry in the *p*-Be cross section at 6 GeV/c. The results is $(\sigma_+ - \sigma_-)/(\sigma_+ + \sigma_-) = (5 \pm 9) \times 10^{-6}$ where $\sigma_+(\sigma_-)$ is approximately the *p*-Be total cross section for positive (negative) beam helicity. Systematic errors are determined to be $< 5 \times 10^{-6}$. (auth)

10475 PION PRODUCTION ON NUCLEI AT 185 MeV. Dahlgren, S.; Grafstroem, P.; Hoeistad, B.; Aasberg, A. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). pp 254-261 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Pion production on nuclei with the residual nucleus left in the ground state or an excited state was studied with 185-MeV protons. Energy spectra of pions, in the energy range 17 to 48 MeV and in the angular region 15 to 130° (lab), were measured with a magnetic spectrometer and a system of scintillation counters. Positive pion spectra were recorded from the target nuclei ^{13}C, ^{16}O, ^{28}Si and ^{40}Ca. Angular distributions for pion production leading to individual states of the residual nuclei are presented. Negative pion production from ^{13}C leading to the ground state of ^{14}C are also presented. A calculation based on a one-nucleon reaction model are compared with improved experimental results from pion production on ^{12}C. (auth)

10476 THE (p,π^+) REACTION AND NUCLEAR STRUCTURE. Eisenberg, J. M.; Noble, J. V.; Weber, H. J. (Virginia Univ., Charlottesville (USA). Dept. of Physics). pp 270-273 of Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The (p,π^+) reaction was studied at 185 and 600 MeV in the distorted wave Born approximation (DWBA) to compare with recent experiments. Eikonal and Sopkovich formalisms are applied in order to minimize off-shell effects. Using Eckart wave functions to insure appropriate asymptotic behavior for the single-particle bound states, cross sections are produced of correct size, but wrong shapes, within reasonable ranges of nuclear size parameters. The consequences of modifying the single-particle bound-state wave functions, and the effects of collective admixtures were examined; both are significant. Thus, there are a sufficient number of ambiguities in the theory that it is difficult to extract definitive information on the behavior of nuclear wave functions at small distances. (auth)

10477 CONSISTENT ANALYSIS OF THE PRODUCTION AND ABSORPTION OF PIONS NEAR THRESHOLD. Dillig, M.; Huber, M. G. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Inst. fuer Theoretische Physik). pp 274-278 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

In the framework of the Jastrow model the proton-induced production of π^+ and π^- at E_p = 185 MeV as well as the two nucleon absorption of bound π^- was analyzed using the nonrelativistic, Galilei-invariant pion–nucleon interaction. It turns out that short-ranged nucleon–nucleon correlations do change the independent particle model (IPM) predictions drastically: the ^{12}C(p,π^+) reaction is enhanced roughly by two orders of magnitude, in general agreement with the experimental observation; in the same model a mechanism for the (p,π^-) reaction is provided: with the same assumptions it is possible to reproduce both the magnitude and the angular distribution of negatively charged pions; the two-nucleon absorption mechanism of this model accounts quantitatively for the lifetime of bound π^- in light nuclei, i.e., of the widths of π-mesic atoms. From this analysis it can be concluded that short range correlations between nucleons play an important role in π-induced reactions: more detailed experimental information about such reactions may yield valuable information on both the nuclear structure properties and on the π-nucleon interaction Hamiltonian. (auth)

10478 DEEP-LYING HOLE STATES STUDIED IN (p,d) REACTIONS. Kaelne, J.; Fagerstroem, B. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). pp 369-378 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Results from (p,d) studies of nuclei between ^{12}C and ^{40}Ca are presented. At E_p = 185 MeV separation energy (E_s) spectra down to $E_s \simeq 80$ MeV were measured which thus covered the region of binding energies for the inner shells 1s and 1p as measured by quasi-free-scattering (e.g., (p, 2p)) experiments. Comparisons show that there is a clear resemblance between E_s-spectra of (p,2p) and (p,d). The 1s and 1p nucleons claimed to have been observed in (p,2p) would thus for the first time have been observed in pickup. The present experiment indicates that the large internal widths connected with the "1s" and "1p" states may have a multi-component structure. For a few target nuclei E_s-spectra were recorded at different angles giving angular distributions in agreement with DWBA calculations. (auth)

10479 THE (p,pd) REACTION ON ^{6}Li AT 590 MeV. Kitching, P.; Olsen, W. C.; Dollhopf, W.; Lunke, C.; Perdrisat, C. F.; Priest, J. R.; Roberts, W. K. (Space Radiation Effects Laboratory, Newport News, Virginia, USA). pp 379-382 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

In a kinematically complete experiment with 590-MeV protons, the reaction ^{6}Li(p,pd) was studied for recoil momenta up to 240 MeV/c. When the results are interpreted in terms of the plane wave impulse approximation (PWIA), it is found that the number of α-d clusters in ^{6}Li is 0.78 ± 0.10. If the momentum distribution is fitted with a Gaussian of the form $e^{-(q/q_0)^2}$, the best fit is

obtained with a width parameter $q_0 = 73 \pm 1.6$ MeV/c, in agreement with previous results at lower recoil momenta. (auth)

10480 DIFFERENCE OF TOTAL CROSS SECTIONS FOR $\pi^{\pm}$ ON ^{9}Be AND THE π^{-9}Be EFFECTIVE COUPLING CONSTANT. Ericson, M. (Lyon-1 Univ., 69 – Villeurbanne (France). Inst. de Physique Nucleaire); Krell, M. (University of Sherbrooke, Canada). Nucl. Phys., A; 241: No. 3, 487-492(14 Apr 1975).

An extrapolation was performed below 100 MeV of the difference in the total cross sections for $\pi^{\pm}$ on ^{9}Be by means of an optical potential. This low energy region gives a nonnegligible contribution to the π^{-9}Be effective coupling constant. (auth)

10481 KINETIC AND SEPARATION ENERGIES OF BOUND PROTONS FROM (e,e'p) REACTIONS. Bernheim, M.; Bussiere, A.; Gillebert, A.; Mougey, J.; Phan Xuan Ho; Priou, M.; Royer, D.; Sick, I.; Wagner, G. J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). pp 387-390 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The (e,e'p) reactions on ^{12}C, ^{28}Si, ^{40}Ca and ^{58}Ni were measured at 500 MeV. The analysis of the carbon data including distorted wave corrections show significant deviations from a Hartree–Fock picture of the nucleus. (auth)

10482 EXTENDED BASIS SHELL-MODEL STUDY OF TWO-NEUTRON TRANSFER REACTIONS. Ibarra, R. H. (University of the Philippines, Quezon City); Vallieres, M. (Pernambuco Univ., Recife (Brazil). Instituto de Fisica); Feng, D. H. (Texas Univ., Austin (USA). Center for Nuclear Studies). Nucl. Phys., A; 241: No. 3, 386-406(14 Apr 1975).

A method to calculate two-nucleon overlaps is presented. The approach is based on shell-model techniques and the effect of one and two nucleons in the continuum are included implicitly. The reactions ^{18}O(p,t)^{16}O and ^{16}O(t,p)^{18}O (ground and excited O^{+} states) are analyzed within the zero-range and finite-range DWBA framework. The differential cross sections calculated using the overlaps obtained by the present method are compared with the ones obtained by the standard well depth (WD) and Jaffe-Gerace (JG) techniques. It is shown that the WD approach yields cross sections smaller than the experimental values by an order of magnitude while the JG method predicts undue energy dependence in the cross section. The approach removes these difficulties and is shown to be consistent with the one-nucleon transfer calculation. (auth)

10483 ELASTIC AND INELASTIC SCATTERING OF 1 GeV PROTONS. Thirion, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Physique Nucleaire). pp 168-175 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The facility, SPES I, is a spectrometer used in the energy loss type with the following characteristics: best measured resolution 100 keV; solid angle 3×10^{-3} sr; momenta up to 2 GeV/c; localizations on the focal plane are obtained with an array of 50 cm drift counters (1 mm precision); zero time is given by a telescope of scintillation and Cherenkov counters. Data were obtained for ^{12}C, ^{58}Ni, ^{208}Pb, ^{16}O, and ^{40}Ca. Analysis of the Glauber and KMT type is in progress; difficulties for large momentum transfers are observed. The near future should provide data for ^{6}Li, ^{4}He, and ^{24}Mg. (auth)

10484 A SEARCH FOR PARITY-NON-CONSERVING EFFECTS IN THE ^{12}C(α,γ)^{16}O REACTION. Bellotti, E.; Fiorini, E.; Negri, P. (Milan Univ. (Italy). Istituto di Fisica). pp 63-66 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A search was made for parity-nonconserving reactions ^{12}C (α,γ) ^{16}O leading to the ($J^{\pi} = 0^{-}$; I = 0) level at 10.952 MeV and to the (3^{+},0) level at 11.080 MeV of ^{16}O. These levels should be much favored due to parity mixing with near levels with the same spin and isospin and opposite parity. Targets enriched to 99.9% ^{12}C were exposed to beams of α-particles and the emitted γ-rays were detected with a 75 cm^{3} Ge(Li). No evidence for the parity-forbidden states appears in the γ-spectra and upper limits of 6×10^{-4} eV and 5×10^{-4} eV can be set with 80% confidence for the parity-violating widths of the 10.952 and 11.080 levels, respectively. The corresponding limits on the parity-nonconserving parameter F are $F^{2} < 2 \times 10^{-10}$ and $F^{2} < 6 \times 10^{-10}$, respectively. (auth)

10485 WHAT IS THE NORMALIZATION OF ^{6}Li. Noble, J. V. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Phys. Lett., B; 55: No. 5, 433-435(17 Mar 1975).

The wave function for ^{6}Li, viewed as a bound state of deuteron and alpha particle, must be renormalized because of the compositeness of its constituents. The nearness of the 3-body α + n + p threshold suggests that the most important effect is the virtual dissociation of the deuteron. An approximate value of the renormalization, based on this hypothesis, is derived. (auth)

10486 "EXACT" SHELL MODEL CALCULATIONS AND LINKED NUCLEAR EFFECTIVE INTERACTIONS. Goode, P. (Rutgers–the State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Nucl. Phys., A; 241: No. 2, 311-316(7 Apr 1975).

It is shown that so-called "exact" shell model calculations of spectra (diagonalizations) contain important unlinked terms which are due to space truncation. These terms render less interesting a comparison between the "exact" calculation of spectra and model space calculations with effective interactions containing linked terms only. The spectral calculations were performed in mass 6. The lowest order unlinked terms which arise in the "exact" calculation were calculated in mass 6 and mass 18. (auth)

10487 A SEPARABLE POTENTIAL APPROACH TO NUCLEON-NUCLEUS SCATTERING WITH EXACT TREATMENT OF COULOMB INTERACTIONS. Cattapan, G.; Pisent, G.; Vanzani, V. (Padua Univ. (Italy). Istituto di Fisica). Nucl. Phys., A; 241: No. 2, 204-218(7 Apr 1975).

A suitable, physically reasonable choice of separable nucleon-nucleus potential is made, which leads to very simple analytic expressions for the form factors in the Coulomb-state representation. This allows one to take account of Coulomb effects in an exact and simple way. The model is applied to the analysis of the elastic scattering of nucleons by ^{4}He, ^{12}C and ^{16}O targets. A good fit of the experimental phase shifts is obtained with almost the same values of the potential parameters for neutron-nucleus and proton-nucleus elastic scattering. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 8449, 9005, 9748, 10466, 10468, 10471–10472, 10475, 10478, 10481, and 10516.

10488 (CEA-CONF-2961) SPIN-PARITY ASSIGNMENTS FOR HIGH-LYING LEVELS IN ^{27}Al. Uzureau, J.; Adam, A.; Joly, S. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1974. 1p. INIS.

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The preliminary results of investigations using the ^{26}Mg(d,n)^{27}Al reaction at deuteron energies of 6 and 8 MeV are reported. (FR)

10489 (COO-2479-2) MEASUREMENT OF NEUTRON TOTAL CROSS SECTIONS OF SODIUM NEAR MINIMA. Brown, P. H.; Quan, B. L.; Weiss, J. J.; Block, R. C. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). Dept. of Nuclear Engineering). 1974. Contract AT(11-1)-2479. 4p. (CONF-750607-3). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The deep minima in the neutron total cross section of Na are important in an LMFBR since it is these minima that determine the characteristics of deeply penetrating flux. Thick sample Na neutron transmission measurements have been performed using the filtered beam technique to determine these minima precisely. The data are compared with ENDF/B IV results and agree to within experimental error. (1 table, 1 figure) (SDF)

10490 (IPNO–1972, pp 11) STUDY OF ANALOG ISOBAR RESONANCES USING ^{31}P(p,γ)^{32}S AND ^{31}P(p,p)^{31}P REACTIONS. Langevin, M.; Maison, J. M.; Vernotte, J. [nd]. (In French).

In 1972 annual report. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire).

The study of fourteen resonance levels in the ^{31}P(p,γ)^{32}S and ^{31}P(p,p)^{31}P reactions was completed. Seven levels seem to be the analogs of odd-parity levels in ^{32}P. (auth)

10491 (IPNO-1972, pp 12) STUDY OF THE LOWEST T = 2 STATE OF ^{32}S. Langevin, M.; Maison, J. M.; Vernotte, J. [nd]. (In French).

In 1972 annual report. (Paris-11 Univ., 91- Orsay (France). Inst. de Physique Nucleaire).

The lowest T = 2 state was observed in ^{32}S by means of the $^{31}P(p,\gamma)^{32}S$ reaction. The $^{31}P(p,p)^{31}P$ reaction was also studied. The gamma-decay scheme, the J = 0 assignment and an upper limit of the width GAMMA = 230 eV were obtained for this state. (auth)

10492 EXCITATION OF T = 3/2 STATES IN ^{25}Mg AND ^{29}Si BY $(^3He,\alpha)$ REACTIONS. Richter, R. Heidelberg; Univ. Heidelberg (1971). 56p. (In German). INIS.

Thesis.

Angular distributions of the reactions $^{26}Mg(^3He,\alpha)^{25}Mg$ and $^{30}Si(^3He,\alpha)^{29}Si$ were measured with the aim to investigate highly excited T = 3/2 states in ^{25}Mg and ^{29}Si. (Bombardment energy: 15.4 MeV). The α-particles were detected by a magnetic spectrograph. The energy of eight T = 3/2 states seen in ^{25}Mg and ^{29}Si was determined up to ± 7 keV. From the comparison between angular distributions and dwba-calculations l-values, spectroscopic factors and total cross sections could be determined. (auth)

10493 DIFFERENTIAL CROSS SECTIONS FOR ELASTIC AND INELASTIC SCATTERING OF 3.45 MeV AND 4.17 MeV NEUTRONS FROM ^{27}Al. Johnsen, P. Kiel; Univ. Kiel (1972). 63p. (In German). INIS.

Thesis.

The elastic and inelastic scattering of fast neutrons from ^{27}Al nuclei is investigated using the time-of-flight method. In the time-of-flight spectrum belonging to a solid angle, the group of elastically scattered neutrons and three or four inelastic scattered groups under excitation of the ^{27}Al nucleus could be separated. The differential cross sections for elastic and inelastic scattering are absolutely determined from the number of scattered neutrons in the group concerned. Furthermore, the partial cross sections, integrated over the solid angle and the total cross sections are determined. The measured angular distribution of the elastically scattered neutrons is compared with the calculated values according to the optical model. (auth)

10494 EXPERIMENTAL DETERMINATION AND DWBA-ANALYSIS OF TRANSITION MATRIX ELEMENTS IN THE REACTION $^{26}Mg(\alpha,\alpha'\gamma)^{26}Mg$. Wagner, H. J. M. Erlangen, Ger.; Univ. Erlangen-Nurenberg (1974). 48p. (In German). INIS.

Thesis.

With the help of 15 MeV α-particles the angular correlation between inelastic scattered α-particles and coincident γ was investigated in the reaction chain $^{26}Mg(\alpha,\alpha')^{26}Mg^*(\gamma)^{26}Mg$. The $^{26}Mg^*$-states were found up to an excitation energy of 4.4 MeV. The analysis of the measured matrix elements leads to following results in the frame of DWBA: Some DWBA calculations with different model parameters could describe well the angular distribution of the elastic and inelastic cross section nevertheless none of these could fit the matrix element dependence on the scattering angle. From the random coincidence between experimental and theoretical cross sections and the failure of reaction theory in detail it follows that analysis of differential cross sections is not enough for an investigation of the reaction mechanism. Furthermore it was showed that transition matrix elements react more sensitive upon changes of the model parameters than the differential cross sections. (auth)

10495 STUDY OF THE γ-DECAY OF THE LOWEST ANALOG STATES IN ^{33}S, ^{41}Ca, AND ^{47}Ti BY THE REACTIONS $^{31}P(^3He,p\gamma)^{33}S$, $^{39}K(^3He,p\gamma)^{41}Ca$ AND $^{45}Sc(^3He,p\gamma)^{47}Ti$. Knoepfle, K. T. Heidelberg; Univ. Heidelberg (1971). 69p. (In German). INIS.

Thesis.

The reactions $^{31}P(^3He,p\gamma)^{33}S$, $^{39}K(^3He,p\gamma)^{41}Ca$ and $^{45}Sc(^3He,p\gamma)^{47}Ti$ were investigated at ^3He energies of 12 and 13 MeV to get information about the γ decay of the lowest analog states in the final nuclei ^{33}S, ^{41}Ca and ^{47}Ti. These states are excited very strongly in the $(^3He,p)$ reaction by a L = 0 proton-neutron transfer pair. The γ radiation was determined in a Ge(Li)-counter under right angle to the incoming beam in coincidence with the protons, which were measured in a semiconductor counter under 0°. (GE)

10496 γ-SPECTROSCOPIC INVESTIGATIONS OF HIGHLY EXCITED STATES IN ^{25}Mg. Glattes, V. Freiburg i.B.; Univ. Freiburg i.B. (1973). 46p. (In German). INIS.

Thesis.

The γ-decay of highly excited states in ^{25}Mg above 5 MeV excitation energy was investigated. For all bound and some unbound states the branching ratios were found. Additionally some states above 5 MeV were found which allow a classification in the Nilsson model. It was shown that the single particle properties of $1/2^+$ bands could be declared by the rotational-vibrational-model. (auth)

10497 JOHNSON AND SOPER'S METHOD OF INCLUDING DEUTERON BREAK-UP FOR THE CALCULATION OF STRIPPING CROSS SECTIONS. Rawitscher, G. H. (Connecticut Univ., Storrs (USA)). Nucl. Phys., A; 241: No. 3, 365-385(14 Apr 1975).

The equations of Johnson and Soper (JS) are re-derived by utilizing an expansion of the deuteron-nucleus wave function in terms of the continuum eigenstates of the neutron-proton Hamiltonian, and are generalized so as to allow for breakup states in which the relative neutron-proton angular momenta l_1 are different from zero. Apart from the ab initio neglect of the breakup energies, the approximation required to establish these equations are found to be acceptable. A numerical application for the case of 21.6-MeV (d,p) reactions on ^{40}Ca shows that the $l_1 = 2$ breakup continuum has a small effect on the $\Delta l = 3$ and $\Delta l = 1$ stripping cross sections. A sum rule, expressing the generalized JS potentials in terms of potentials which depend on the individual breakup momenta, is established. Numerical application to the 21.6-MeV d-^{40}Ca example shows that the $l_1 = 0$ breakup spectrum contains breakup energies at least as large as 10 MeV, and that the $l_1 = 2$ spectrum requires inclusion of breakup energies up to about 40 MeV. It is concluded that the neglect of breakup energies in the derivation of the JS equations requires further investigation. (auth)

10498 STRUCTURE OF 0^+ STATES IN ^{40}Ca. Fortune, H. T.; Betts, R. R.; Bishop, J. N.; Al-Jadir, M. N. I.; Middleton, R. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Phys. Lett., B; 55: No. 5, 439-442(17 Mar 1975).

The $^{36}Ar(^6Li,d)^{40}Ca$ reaction was studied with emphasis on the population of 0^+ final states. These data, in comparison with data from previous two- and multinucleon transfer reactions, are used to elucidate the probable dominant configurations of the 0^+ states in ^{40}Ca. (auth)

10499 LIFETIME AND BRANCHING MEASUREMENTS ON THE $K^\pi = 0^+$ AND $K^\pi = 2^+$ ^{24}Mg ROTATIONAL LEVELS. Branford, D.; McGough, A. C.; Wright, I. F. (Manchester Univ. (UK). Dept. of Physics). Nucl. Phys., A; 241: No. 2, 349-364(7 Apr 1975).

The ^{24}Mg ground state $K^\pi = 0^+$ rotational band and the $K^\pi = 2^+$ band built on the 4.24 MeV 2^+ level were studied using the ^{12}C $(^{16}O,\alpha)^{24}Mg$ reaction. The results of lifetime measurements, made using the Doppler shift attenuation method, and γ-branching ratio determinations are reported. These give an unambiguous assignment of $J^\pi = 6^+$ to the 8.11 and 9.53 MeV levels. The results for the 13.21 MeV $(8^+, 6^+)$ level and a new level at 12.35 MeV support assignments of J^π, $K = 8^+$, 0 and $(7^+, 2)$ to these levels, respectively. All the intraband E2 transition strengths are in reasonable agreement with both the rotational model and recent shell model calculations although the interband E2 strengths are in poor agreement. No evidence for band mixing was observed and an upper limit of 2.5% is given for the fractional amplitude of the 2^+, 0 state mixed into the 2^+, 2 state. (auth)

10500 INELASTIC ELECTRON SCATTERING FOR ^{31}P. Kline, F. J.; Lin, C. L.; Peterson, G. A. (Massachusetts Univ., Amherst (USA)); Penner, S. (National Bureau of Standards, Washington, D. C. (USA). Center for Radiation Research). Nucl. Phys., A; 241: No. 2, 299-310(7 Apr 1975).

Form factors for the electroexcitation of the $1/2^+$ (1.27 MeV), $5/2^+$ (2.23 MeV), and $3/2^+$ (3.51 MeV) states in ^{31}P were measured for momentum transfers from 0.36 to 0.80 fm^{-1} at the NBS electron scattering facility. In addition, form factors for the 2.23-MeV state in the momentum transfer range 0.74 to 1.78 fm^{-1} were extracted from data obtained in a previous experiment. Using the DUELS distorted-wave code the $B(E2,\omega)$'s were found to be 6.0 ± 0.9, 6.9 ± 0.3, and 2.7 ± 0.3 W.u. for the 1.27, 2.23, and 3.51 MeV states, respectively. The form factors for these states, calculated using wave functions derived in an intermediate-coupling vibrational calculation, are compared with the data. (auth)

10501 THE $^{30}Si(p,d)^{29}Si$ AND $^{30}Si(p,t)^{28}Si$ REACTIONS AT 27 MeV. Haight, R. C.; Proctor, I. D.; Lutz, H. F.; Bartolini, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nucl. Phys., A; 241: No. 2, 285-298(7 Apr 1975).

The $^{30}Si(p,d)^{29}Si$ and $^{30}Si(p,t)^{28}Si$ reactions were studied using a 27-MeV proton beam from the Livermore cyclograaff. Angular distributions were obtained for energy levels to 9.7 MeV in ^{29}Si and 7.4 MeV in ^{28}Si. A DWBA analysis was performed to extract spectroscopic factors and enhancement ratios for the one- and two-neutron pickup reactions. The results are compared with previous neutron pickup experiments and with a microscopic shell-model calculation. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 8449, 10483, and 10560.

10502 PROTON HOLE STATES EXCITED BY MONOENERGETIC GAMMA QUANTA. Wene, C. O. (Lund Univ. (Sweden). Dept. of Nuclear Physics). Z. Phys., A.; 272: No. 1, 77-87(1975).

The high energy photoproton spectra from ^{45}Sc, ^{51}V, ^{59}Co, ^{58}Ni, ^{63}Cu and natural nickel were measured with 60 to 120-keV resolution using the 17.62-MeV γ-quanta produced by the ^{7}Li(p,γ)^{8}Be-reaction. The absolute cross sections for transitions to levels in the daughter nucleus were determined. The results are compared with a simple model assuming a semidirect reaction proceeding via a dipole doorway state. Good correlation is found between the cross sections and the spectroscopic factors measured in proton pickup reactions. (auth)

10503 INVESTIGATION OF MULTIPLET STATES IN THE (1f7/2)-SHELL BY (d,α) REACTIONS. Hoerle, J. Bonn; Univ. Bonn (1974). 30p. (In German). INIS.

Thesis.

At a deuteron energy of 15 MeV the reactions ^{58}Ni(d,α)^{56}Co, ^{54}Fe(d,α)^{52}Mn, ^{50,52}Cr(d,α)^{48,50}V and ^{50}Ti(d,α)^{48}Sc were pursued. Angular distributions were measured for the 7^{+}-states of the final nuclei. Within a systematic dwba-analysis the purity of 7^{+}-states could be proved by determination of spectroscopic factors. For the final nuclei ^{52}Mn, ^{50}V and ^{48}Sc the (1f$^{7}_{2}$) multiplet structure of excited states is discussed in the framework of the shell model. (auth)

10504 ^{3}He-SCATTERING FROM Ca, Ti, AND Cr ISOTOPES. Morsch, H. P. Heidelberg; Univ. Heidelberg (1971). 68p. (In German). INIS.

Thesis.

The elastic and inelastic ^{3}He-scattering from ^{40,44,48}Ca, ^{46,48,50}Ti and ^{50,52,53}Cr was measured with multi-counter telescopes at 29 MeV. The angular distribution of elastic scattering could be fitted by the optical model with an intermediate standard parameter set except for ^{40}Ca. (auth)

10505 γ-SPECTROSCOPY AT ^{16}O AND ^{18}O INDUCED TRANSFER REACTIONS ON ^{90,96}Zr, ^{100}Mo, ^{154}Sm, ^{159}Tb AND ^{208}Pb NEARLY COULOMB THRESHOLD. Bohn, H. Munich; Technische Univ. (1973). 50p. (In German). INIS.

Thesis.

It is the aim of this work, to present an analysis about the possibility and the use of γ-spectroscopy for heavy ion transfer reactions with intermediate mass and heavy nuclei. The reactions and the γ-decay of the excited final nuclei are analyzed at projectile energies near the Coulomb threshold. For the inelastic scattering characteristic deviations are found from semiclassical theory; the influence of nuclear forces are estimated. (auth)

10506 MAGNETIC MOMENT OF ^{57}Ni. Rosenblum, S. S.; Steyert, W. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Phys. Lett., B; 55: No. 5, 450-452(17 Mar 1975).

An extra neutron added to a doubly magic nuclear core should give a nuclear magnetic moment, μ, in close agreement with the Schmidt value. However, the magnetic moment of ^{57}Ni, measured through nuclear alignment of 3 to 20 mK, is equal to $|\mu| = 0.88 \pm 0.06\ \mu_N$ which is only 45% of the Schmidt value. Comparison with several nuclear structure calculations is made. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 10502, 10505, 10548, and 10560.

10507 (CEA-CONF-2964) SENIORITY IN SHELL MODEL WAVE-FUNCTIONS OF COPPER ISOTOPES. Duchemin, B. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1974. 1p. INIS.

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

In many shell model calculations, only the lowest seniority states are included in the model space. To test the validity of this approach, the percentage of lowest seniority states in the wave functions of copper isotopes were investigated by a shell model calculation. The results obtained are given for the first five low-lying levels of ^{60}Cu. Results for ^{59}Cu, ^{61}Cu and ^{62}Cu show similar trends. (FR)

10508 (JINR-P6-8497) DECAY OF THE LIGHTEST Rb ISOTOPES. Bogdanov, D. D.; Voborzhil, I.; Dem'yanov, A. V.; Karnaukhov, V. A.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Mass-separator BEMS-2 operating in the JINR cyclotron heavy ion beam, was used. Light isotopes of Rb were separated when bombarding the ^{58}Cr target with the ^{32}S beam. The lifetimes for ^{78}Rb and ^{76}Rb were determined more accurately, and γ-ray spectra, following the β-decay of these isotopes, were measured. A conclusion is drawn about the ^{76}Rb spin. (1 figure, 1 table) (auth)

10509 s- AND p-WAVE NEUTRON SPECTROSCOPY. XC. Intermediate Structure: ^{88}Sr. Malan, J. G.; Pineo, W. F. E.; Divadeenam, M.; Choi, B. H.; Bilpuch, E. G.; Newson, H. W. (Duke Univ., Durham, NC). Ann. Phys. (N. Y.); 89: No. 2, 284-298(Feb 1975).

Neutron total cross section measurements of natural Sr were made from 50–875 keV using a high resolution proton beam and the ^{7}Li(p,n) reaction as a neutron source. These data were analyzed with the help of an R-Matrix code to extract resonance (energies and other) parameters up to about 850 keV. 2p-1h and particle-vibration doorway interpretation of the s-, p- and d-wave resonances is attempted in terms of the sum rule SIGMA gamma^{2}/sub n/ equals gamma^{2}/sub d/. Predictions based on both of these models agree with the experimental results. As expected the p-wave resonances are stronger than either s- and d-wave structure. Theory accounts for the p-wave strength remarkably well. Possible location of the p-wave s.p. resonance is reproduced with a real potential and its damping due to the imaginary potential is calculated. More fragmentation of the strong p-wave doorways is observed than was expected for a compound nucleus so near ^{90}Zr, but a larger strength function is observed apparently due to the p-wave giant resonance. (7 figures, 6 tables) (auth)

10510 GAMMA-RAY EMISSION FROM SHORT–LIVED BROMINE AND IODINE ISOTOPES. Kratz, K. L.; Lauppe, W.; Herrmann, G. (Mainz Univ.). Inorg. Nucl. Chem. Lett.; 11: No. 5, 331-339(May 1975).

Half-lives and main γ-rays have been assigned to ^{88}Br to ^{92}Br and ^{137}I to ^{141}I. The mass assignments are based on the genetic relationship of these nuclides to known decay products. Element assignments have been supported by coincidence measurements of x-rays and γ-rays of unseparated fission products from ^{235}U(n$_{th}$,f). (auth)

10511 MEASUREMENT OF THE TOTAL NEUTRON CROSS SECTIONS OF CARBON, YTTRIUM, AND BISMUTH IN THE ENERGY REGION FROM 1.0 TO 5.0 MeV. Ai, C. F.; Chou, J. C. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 4, 179-188(Dec 1974).

The total neutron cross sections of carbon, yttrium and bismuth have been measured in the energy range from 1.0 to 5.0 MeV at a 7 MV Van de Graaff accelerator. Neutrons were produced by the ^{7}Li(p, n)^{7}Be reaction. A liquid scintillation detector (NE 213) embedded in a well-collimated shielding tank was used for neutron detection. Time-of-flight method together with the pulse shape n, γ discrimination eliminated effectively the background due to gamma-rays and scattered neutrons. Nuclear optical model calculations, code ELIESE–I, with generalized parameters for the total cross sections of yttrium and bismuth were carried out and compared with the experimental values. The calculated results of carbon by using the phase shift method have been taken for comparison. Results from existing measurements are also mentioned. Discussions and intercomparison are included. (3 tables, 8 figures) (auth)

10512 HIGH SPIN STATES IN ^{75}Se POPULATED BY THE ^{72}Ge(α,n) and ^{73}Ge(α,2n) REACTION. Zell, K. O.; Friedericks, H. G.; Heits, B.; Brentano, P. von (Koeln Univ. (F. R. Germany). Inst. fuer Kernphysik); Protop, C. (Institutul de Fizica Atomica, Bucharest (Romania)). Z. Phys., A.; 272: No. 1, 28-38(1975).

The ^{72}Ge(α,n)^{75}Se and ^{73}Ge(α,2n)^{75}Se reactions were studied at bombarding energies of 15 and 22.5 MeV respectively using Ge(Li)-detectors. The γ-singles spectra, γ–γ-coincidences, γ-angular distributions and excitation functions were taken. A level scheme was constructed, which contains a stretched spin and a normal rotational band. (auth)

10513 OPTICAL MODEL ANALYSIS OF PROTON ELASTIC SCATTERING EXCITATION FUNCTIONS AROUND A = 90. Schulte, K.; Berg, G.; von Brentano, P.; Paetz gen. Schieck, H. (Koeln Univ. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 241: No. 2, 272-284(7 Apr 1975).

Excitation functions of protons elastically scattered from ^{88}Sr, ^{89}Y, ^{90}Zr and ^{92}Mo over an energy range from 8 to 15 MeV were analyzed with the optical model. The deep minima exhibited by these excitation functions especially at extreme backward angles can be described by an imaginary potential which is smaller than that of Becchetti and Greenlees. Compound nucleus contributions were taken into account by appropriate weighting of the data. The magnitude of these contributions in the minima could thus be estimated. (auth)

10514 INTEGRAL ROTATION OF 3/2^{-} LEVELS IN ^{65}Zn AND ^{67}Zn. Wender, S. A.; Cameron, J. A. (McMaster Univ., Hamilton Ontario (Canada). Dept. of Physics). Nucl. Phys., A; 241: No. 2, 332-340(7 Apr 1975).

Low lying levels of ^{65}Zn and ^{67}Zn were excited by the Ni(α,n)

reaction using enriched Ni and $Ni_{10}Fe_{90}$ targets. From the angular distributions of gamma rays, E2/M1 mixing ratios were obtained. In the iron alloy targets, integral spin precession was observed and used to measure the g-factors of two $3/2^-$ levels of ^{65}Zn. The results are discussed in terms of the shell and unified models of the odd Zn isotopes. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 10159, 10505, 10510, 10513, 10548, 10560, 10565, and 10574.

10515 (CERN-74-8, pp 41-57) THE PRESENT AND FUTURE OF NUCLEAR STRUCTURE WITH HADRONIC PROBES. Tanner, N. W. 10 Apr 1974.

From topical meeting on intermediate energy physics; Zuoz, Switzerland (4 Apr 1973).

In topical meeting on intermediate energy physics, Lyceum Alpinum, Zuoz, Engadin, Switzerland, 4–13 April 1973. Proceedings. (Schweizerisches Inst. fuer Nuklearforschung, Villigen; European Organization for Nuclear Research, Geneva (Switzerland)).

A brief review is given of the use of pions as probes in nuclear structure experiments, including a discussion of the Glauber approximation and other prescriptions for multiple scattering. (auth)

10516 (COO-2479-4) PRECISION NEUTRON CROSS SECTION MEASUREMENTS IN SUPPORT OF THE LMFBR PROGRAM. Progress Report, October 1, 1974–December 31, 1974. Block, R. C.; Hockenbury, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). 1974. Contract AT(11-1)-2479. 10p. Dep. NTIS $4.00.

Neutron capture cross sections have been determined for ^{145}Nd, ^{149}Sm, ^{101,102,104}Ru, ^{242}Pu, ^{105}Pd, ^{151,153}Eu, and ^{103}Rh. In addition, total neutron cross sections for sodium near minima have been investigated. One paper (sodium) and abstracts for three other papers are included. (1 table, 2 figures) (SDF)

10517 (INR-1461/I/PL/B) A STUDY OF THE SINGLE PARTICLE LEVELS IN DEFORMED NUCLEI EXCITED IN THE (d,p) AND (d,t) REACTIONS. Jaskola, M. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 159p. (In Polish). INIS.

The angular distributions of triton and proton groups from the ^{144}Sm(d,t), ^{154}Sm(d,t), ^{156}Gd(d,t), ^{160}Gd(d,t), ^{166}Er(d,t), ^{154}Sm(d,p), ^{166}Er(d,p), ^{170}Yb(d,p) and ^{176}Yb(d,p) reactions were measured at deuteron energy 12.1 MeV. The reaction products were observed with a solid state counter telescope and with a magnetic spectrograph and photographic plate recording. The angular distributions were compared in selected groups with l = 0,1,2,3,4,5 and 6. The results were analyzed in terms of a distorted wave method. Some results were analyzed with the inclusion of the nonelastic scattering in the entrance and exit channels. It was possible to establish or confirm the Nilsson assignments for a number of levels in the ^{153}Sm, ^{158}Sm, ^{155}Gd, ^{159}Gd, ^{165}Er, ^{171}Yb and ^{177}Yb nuclei. Most of the observed low lying states in the final nuclei are in reasonable agreement with the predictions based on the stripping theory for deformed nuclei and the Nilsson model. (auth)

10518 (JINR-P3-8653) INVESTIGATION OF NEUTRON RESONANCES IN THE REACTION (n,α) ON ^{105}Pd, ^{149}Sm, AND ^{171}Yb NUCLEI. Balabanov, N. P.; Gledenov, Yu. M.; Pak Hong Chol; Popov, Yu.; Semenov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The results of measurements of α-widths in the reaction (n,α) on ^{105}Pd, ^{149}Sm and ^{171}Yb nuclei are presented. The data obtained are compared with the predictions of the statistical theory and the optical model. Attention is paid to a more narrow distribution of α-width for the resonances with spin 4^- of ^{149}Sm than the statistical theory predicts. A search for correlations between neutron and total α-widths in the resonances gave negative results. (4 tables, 4 figures) (auth)

10519 STATES IN ^{95}Mo AND ^{99}Mo POPULATED IN THE (^{3}He,α) REACTION. Schoonover, J.; Cheung, H. C.; Kitching, J. E.; Mark, S. K.; Lee, J. K. P. (McGill Univ., Montreal, Quebec (Canada). Foster Radiation Lab.). Z. Phys., A.; 272: No. 1, 99-105(1975).

The (^{3}He,α) reaction in ^{96}Mo and ^{100}Mo targets has been studied at a bombarding energy of 18 MeV. The l transfer assignments have been made on the basis of the angular distribution patterns and on an analysis of the ratios of the experimental and theoretical cross sections of (^{3}He,α) and (d,t) reactions data leading to the same final states. New states are observed in ^{95}Mo at 3,373 keV ($5/2^+$); spin and parity assignments are made to levels in ^{99}Mo at 1,621 keV $7/2^+$ ($9/2^+$), 1,778 keV ($5/2^-$) and 2,078 keV ($11/2^-$). (auth)

10520 MEASUREMENT OF THE FAST NEUTRON SCATTERING AND TOTAL CROSS SECTIONS OF ^{141}Pr. Singh, R.; Knitter, H. H. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Z. Phys., A.; 272: No. 1, 47-52(1975).

The differential elastic neutron scattering cross sections of ^{141}Pr were measured at the incident neutron energies of 1.2, 1.7 and 1.9 MeV in the angular range between 25 and 150 degrees. At 1.7 MeV the differential inelastic neutron scattering cross sections corresponding to Q = −1,122 keV, and at 1.9 MeV the ones corresponding to Q = −1,122, and Q = −1,295 keV were also determined. In a transmission experiment, the total cross section was measured between 0.50 and 2.42 MeV. The total and differential cross sections were calculated using the nuclear optical model. The calculated results were compared with the experimental data. (auth)

10521 MEASUREMENT OF CHARGED-PION PRODUCTION BY 7.28-GeV NITROGEN IONS. Vosburgh, K.G.; Schimmerling, W.; Koepke, K. (Princeton Particle Accelerator, Princeton University, Princeton, New Jersey 08540); Wales, W.D. Phys. Rev. D 11: No. 7, 1743-1755 (1 Apr 1975).

The differential cross sections for the production of charged π mesons by collisions between 7.28-GeV nitrogen nuclei and ten elemental targets at 3° and 15° were measured at the Princeton Particle Accelerator. The cross sections as a function of atomic weight of the target are consistent with the $A^{1/3}$ dependence expected if the reaction is localized on the nuclear surface, and with the predictions of an "effective nucleon number" model of production via the Δ (1236) isobar. For pion energies below about 415 MeV, the pion yield agrees well with values derived from proton-nucleus data and simple Fermi-motion calculations. Above about 415 MeV the measured cross section is higher than that calculated from nucleon-nucleus cross sections, even after Fermi-motion effects have been taken into account. (auth)

10522 ^{16}O-INDUCED TRANSFER REACTIONS ON EVEN ZIRCONIUM ISOTOPES. Rehm, K. E. Munich; Technische Univ. (1973). 28p. (In German). INIS.

Thesis.

The ^{16}O-induced transfer reactions on even zirconium isotopes were measured at ^{16}O-energies between 48 and 60 MeV. The identification of the reaction products ^{12}C, ^{14}C, ^{15}N and ^{16}O was done by semiconductor telescopes. Between 50 and 170° angular distributions were measured. The differential cross section showed a maximum at grazing angles. The cross sections integrated over all excitation energies are at 54 MeV and 100° for one proton transfer about 2.4 mb/sr. The cross section for the two-proton transfer increases from ^{90}Zr to ^{96}Zr, from 0.2 mb/sr to 1.0 mb/sr, for four-nucleon transfer decreases from 2.1 mb/sr to 0.9 mb/sr however. Furthermore the average excitation energy E^+ was measured as a function of the injection energy and the scattering angle. To higher angles E^+ increases. The experimental values for the excitation energy under backward direction, the width of the energy spectrum and the position of the grazing angle are compared with semiclassical theoretical calculations. It is shown that backward effects may not be neglected. At injection energies near the Coulomb threshold the influence of nuclear forces was estimated for the excitation energy and the grazing angle. (auth)

10523 THE THREE NUCLEON TRANSFER REACTIONS ON EVEN ZIRCONIUM ISOTOPES. Mueller, R. Munich; Technische Univ. (1973). 62p. (In German). INIS.

Thesis.

The (p,α)-reactions on even zirconium isotopes were measured at a proton energy of 16.6 MeV in the angular region from 7.5 up to 170°. The α-particles were identified by semiconductor telescopes. The interpretation of ^{87,89,91,93}Y-spectra followed in the frame of a weak-coupling-model. The proton states were coupled to core-states with neutron configurations which were strongly excited by two-neutron pickup. The coupling of the proton states to the collective 3^--states of the core could not be observed. (auth)

10524 PROTON SPECTROSCOPY OF ^{105}Ag FROM THE (^{3}He,d) REACTION. Anderson, R. E.; Kraushaar, J. J. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). Nucl. Phys., A; 241: No. 2, 189-203(7 Apr 1975).

The ^{104}Pd(^{3}He,d)^{105}Ag reaction was studied at a bombarding energy of 33.3 MeV. Angular distributions were taken for the emergent deuterons from 2.5 to 55° with a typical resolution of 25 keV. Orbital angular momentum transfers and spectroscopic factors were deduced from comparisons with DWBA calculations. Only the ground state and 54-keV state were found to be suitable candidates for quasirotational bandheads. The level structure of ^{105}Ag, ^{107}Ag, and ^{109}Ag as seen with the (^{3}He,d) reaction are compared. (auth)

10525 COUPLING BETWEEN COLLECTIVE AND GENERALIZED NEUTRON PARTICLE-HOLE EXCITATIONS: APPLICATION TO ^{142}Nd. Heyde, K.; Waroquier, M.; Vincx, H. (Institute for Nuclear Physics, INW, Proeftuinstraat 86, B-9000 Gent, Belgium). Nucl. Phys., A; 241: No. 2, 219-228(7 Apr 1975).

Taking into account admixtures of pure collective configurations formed by coupling the one-quadrupole with one-octupole states and also of two quasi-proton (2QP) excitations in the generalized neutron particle-hole scheme (GNPH), a detailed description of the negative parity levels in the energy region 3 MeV $\lesssim E \lesssim$ 4 MeV can be given. Application is made to the case of ^{142}Nd. Total cross sections as well as angular distributions of inelastically scattered protons through the $^{1}/_{2}^{-}(1)$ and $^{3}/_{2}^{-}(1)$ isobaric analog resonances (IAR) are calculated and discussed. (auth)

10526 STATES IN ^{119}Cd STUDIED IN THE DECAY OF ^{119}Ag. Kawase, Y.; Fogelberg, B.; McDonald, J.; Baecklin, A. (Forskningsraadens Lab., Studsvik (Sweden)). Nucl. Phys., A; 241: No. 2, 237-252(7 Apr 1975).

The decay ^{119}Ag → ^{119}Cd ($T_{½}$ = 2.1 ± 0.1 s) was studied. The ^{119}Ag activity was obtained as a mass-separated fission product from the OSIRIS facility. A level scheme was constructed comprising 30 levels. Transition probabilities between some low lying levels were deduced from level half-lives measured with the delayed coincidence technique. A systematic comparison is made with levels in ^{117}Cd and ^{115}Cd. Of special interest in ^{119}Cd is the existence of a $^{5}/_{2}^{-}$ and a $^{1}/_{2}^{-}$ state only 67 and 82 keV, respectively, above the $^{11}/_{2}^{-}$ isomer and a strongly retarded $^{1}/_{2}^{+}$ → $^{5}/_{2}^{+}$ E2 transition. (auth)

10527 THE DIRECT (p,α) PICKUP REACTION ON THE EVEN Zr ISOTOPES. Peterson, R. J.; Rudolph, H. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). Nucl. Phys., A; 241: No. 2, 253-271(7 Apr 1975).

The (p,α) reaction was studied on the four even isotopes of zirconium at a proton energy of 22.8 MeV. At this energy, the reaction mechanism was demonstrated to be a direct pickup, leading primarily to hole states in the residual yttrium. A cluster-transfer DWBA calculation was found to account for the observed shapes of the angular distributions, and in particular, reproduced the striking j-dependence between $^{1}/_{2}^{-}$ and $^{3}/_{2}^{-}$ states. On the basis of the similarity to observed angular distribution to states of known spin, a number of new angular momentum assignments are made. Candidates for states of high spin, up to $^{15}/_{2}^{-}$, are also found. Attempts were made to fit the observations into a weak coupling scheme based on the known single-nucleon holes coupled to states of the zirconium isotopes. (auth)

10528 Ca INDUCED REACTIONS ON ^{141}Pr AND ^{150}Sm: NEW GOLD AND LEAD ISOTOPES ^{176}Au, ^{175}Au, ^{185}Pb. Cabot, C.; Deprun, C.; Gauvin, H.; Lagarde, B.; Le Beyec, Y.; Lefort, M. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 241: No. 2, 341-348(7 Apr 1975).

Reactions induced by a beam of ^{40}Ca ions on ^{141}Pr and ^{150}Sm were studied between 180 and 290 MeV. From the characteristics of the (^{40}Ca, xn) excitation functions and from the systematics of α-decay, the existence of the following new neutron deficient nuclides is deduced ^{176}Au (E_{α} = 6.26 ± 0.01 MeV and $T_{½}$ = 1.25 ± 0.30 sec and E_{α} = 6.29 ± 0.01 MeV), ^{175}Au (E_{α} = 6.44 ± 0.01 MeV) and ^{185}Pb (E_{α} = 6.40 ± 0.01 MeV and 6.48 ± 0.02 MeV). New information is obtained on the α-decay of ^{177}Au and ^{187}Pb. (auth)

10529 MEDIUM ENERGY PION-NUCLEUS SCATTERING. Wilkin, C. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 157-167 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The wealth of experimental information on pion-nucleus scattering presented at the 1971 Dubna conference has led to intensive theoretical work. This review is therefore biased toward the interpretation of data, rather than the presentation of new data. The work is mainly confined to the study of elastic and total cross sections. (auth)

10530 NEUTRON SPECTRA FROM THE NEGATIVE MUON ABSORPTION BY HEAVY NUCLEI AND THE RESONANCE MODEL OF NUCLEAR REACTIONS. Evseev, V. S.; Mamedov, T. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). pp 308-311 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Neutron energy spectra are measured in the energy range 1.6 ≤ E_n ≤ 9.6 MeV from the reaction of nuclear absorption of μ^- mesons in ^{127}I and ^{232}Th. In the low energy part of the spectrum the "temperature" values T of the nucleus produced after emission of the first neutron (1.28 ± 0.05 MeV and 1.46 ± 0.06 MeV for ^{128}Te and ^{231}Ac, respectively) were determined, as were also the density parameters of energy levels "a" of this nucleus. The comparison of the data on μ^- capture with the statistical model predictions shows that this model does not describe the decay process of the quasibound states of an intermediate nucleus. As such states are of few-particle character (in correspondence with the resonance model of nuclear reactions) one has to assume that they do not change their nature up to the neutron decay, even in the heaviest nuclei. (auth)

10531 GAMMA-RAYS AND FRAGMENTS FROM MESON INTERACTIONS WITH NUCLEI. Plendl, H. S. (Florida State Univ., Tallahassee (USA). Dept. of Physics). pp 289-298 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

In recent work on prompt γ-ray spectra following nuclear interactions of stopped and fast mesons, many reaction channels have been observed simultaneously. Reactions resulting in removal of one or several α-particles (or of equivalent nucleons) from the target nucleus were found to have high yields relative to absorption resulting in emission of two nucleons and to fast-meson induced knock-out of a single nucleon. Related work on nucleon and fragment spectra from π^- absorption indicates that four correlated nucleons (two neutrons and two protons) are involved in a relatively large fraction of π^- absorption processes. Common and distinguishing features of these experiments are reviewed, and the results are discussed in terms of possible reaction mechanisms. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 10505, 10517–10518, 10528, 10543, 10546, and 10560.

10532 (IPNO-1972, pp 8) TRANSITION PROBABILITIES OF ROTATIONAL LEVELS IN ^{175}Ta. Ader, B.; Berg, V.; Letessier, J.; Ohlsson, H.; Perrin, N. [nd]. (In French).

In 1972 annual report. (Paris-11 Univ., 91- Orsay (France). Inst. de Physique Nucleaire).

Transition probabilities of rotational levels 3/2 1/2 at 372.6 keV, 1/2 1/2 at 487.6 keV and 3/2 1/2 at 497.4 keV in ^{177}Ta are deduced from a precise measurement of transition intensities of 115.05; 115.65; 186.2 and 186.42 keV. (auth)

10533 (IPNO-1972, pp 10) HALF LIVES OF ^{155}Dy, ^{157}Dy, AND ^{159}Dy ENERGY LEVELS. Kilcher, P.; Paris, P.; Torres, J. P. [nd]. (In French).

In 1972 annual report. (Paris-11 Univ., 91- Orsay (France). Inst. de Physique Nucleaire).

The half lives of the 39.4-keV level ($T_{½}$ = 3.5 ± 0.3 nsec) and the 86.8-keV level ($T_{½}$ = 1.1 ± 0.2 nsec) in ^{155}Dy were measured by γ-conversion electron delayed coincidences techniques. Limit values are given for 136.3, 202.4 and 240.3-keV levels. These values were compared with those obtained for ^{153}Gd levels. (auth)

10534 (JINR-P3-8599) NEUTRON RESONANCE SPINS IN ^{159}Tb FROM THE POLARIZED NEUTRON AND NUCLEUS EXPERIMENT. Alfimenkov, V. P.; Ivanenko, A. I.; Lason, L.; Mareev, Yu. D.; Ovchinnikov, O. N.; Pikel'ner, L. B.; Sharapov, E. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 9p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Spins of 27 neutron resonances in ^{159}Tb have been measured in the experiment with a polarized neutron beam and polarized target using the modernized apparatus on the time-of-flight spectrometer of the IBR-30 pulse reactor. (1 table, 1 figure) (auth)

10535 (JINR-P6-8669) INVESTIGATION OF THE EXCITED STATES OF Tb ISOTOPE. III. ^{153}Dy → ^{153}Tb Decay. Zuber, K.; Vylov, Ts.; Gromova, I. I.; Zuber, Ya.; Ortlepp, Kh. G.; Lebedev, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The γ-rays, conversion electrons and γ-γ coincidences spectra have been investigated in the decay of ^{153}Dy. The decay scheme ^{153}Dy → ^{153}Tb is suggested. (2 figures, 2 tables) (auth)

10536 PROBING THE DEFORMED NUCLEUS. Chapman, R.; Gelletly, W. (Manchester Univ., Eng.). Phys. Bull. (London); 26: 107(Mar 1975).

Nuclear reaction studies with heavy ion projectiles have opened up a new dimension in nuclear structure physics. Systematic studies of high spin states in a wide range of even Z, even N nuclei have been made. The (heavy ion, xn) reaction for medium

heavy nuclei is discussed, in particular, the anomalous behavior of the ground state rotational bands. (UK)

10537 THE DECAY OF ^{174}Ta. Cardoso, M. H.; Klieb, L.; Goudsmit, P. F. A.; Konijn, J. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). Z. Phys., A.; 272: No. 1, 13-26(1975).

Levels in ^{174}Hf excited in the decay of ^{174}Ta have been studied. Measurements of gamma rays, conversion electrons and gamma-gamma time coincidences were performed. The ground state band, the beta-vibrational band, the gamma-vibrational band with its head at 1,226.81 keV, a $K = 3^+$ band at 1,303.42 keV and a $K = 2^-$ octupole band at 1,308.67 keV were observed. Several 2^+ levels with $K = 0$ are excited. The main β^+-branches proceed through allowed or first-forbidden transitions to the 2^+ and 4^+ levels of the ground state band. The character of the $I^\pi = 3(+)$ ground state of ^{174}Ta is discussed. (auth)

10538 HYPERFINE STRUCTURE STUDIES OF THE NUCLEI OF ^{180,182}W AND ^{178,180}Hf WITH THE HELP OF MOESSBAUER-EFFECT. Zioutas, K. Bonn; Univ. Bonn (1972). 73p. (In German). INIS.

Thesis.

A report is given on the Moessbauer experiments on the g-g nuclei ^{180}W, ^{182}W, ^{178}Hf and ^{180}Hf. The experimental assembly is described and the evaluation of the Moessbauer spectra explained. Finally, the various theoretical statements to explain the properties of the examined nuclei according to the presentation of the measured results are dealt with, whereby the "pairing plus quadrupole" model is especially gone into. The influence of the rotational-vibrational interaction in deformed nuclei is explained. (auth)

10539 INVESTIGATION OF GROUND STATE ROTATIONAL BANDS OF ^{154}Dy, ^{164}Er AND ^{162}Yb BY $(\alpha,x n\gamma)$-REACTIONS. Banaschik, M. V. Bonn; Univ. Bonn (1973). 61p. (In German). INIS.

Thesis.

The ground state rotational bands of the even-even nuclei ^{154}Dy, ^{164}Er and ^{162}Yb were excited by the nuclear reactions ^{154}Gd$(\alpha,4n\gamma)^{154}$Dy, ^{164}Dy$(\alpha,4n\gamma)^{164}$Er and ^{164}Er$(\alpha,6n\gamma)^{162}$Yb. The γ-radiation levels were measured by Ge(Li) detectors. The levels of the ground state rotational bands could be determined for ^{154}Dy up to 14^+, for ^{164}Er up to 16^+ and for ^{162}Yb up to 14^+ from the experimental data. The results were compared with two phenomenological models. (auth)

10540 THREE-QUASIPARTICLE STATES IN ^{177}Ta. Barneoud, D.; Andre, S.; Foin, C. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Phys. Lett., B; 55: No. 5, 443-446(17 Mar 1975).

The feeding of the $21/2^-$, 1355 keV isomeric state in ^{177}Ta in the ^{175}Lu $(\alpha,2n)^{177}$Ta reaction was studied by means of the delayed coincidence technique. Three other three-quasiparticle states were observed, and their configuration is proposed. (auth)

10541 NEGATIVE-PARITY STATES IN ^{153}Gd AND A QUADRUPOLE-OCTUPOLE COUPLING MODEL. Zolnowski, D. R.; Kishimoto, T.; Gono, Y.; Sugihara, T. T. (Texas Agricultural and Mechanical Univ., College Station (USA). Cyclotron Inst.). Phys. Lett., B; 55: No. 5, 453-456(17 Mar 1975).

Odd-spin negative-parity states to spin 17 were identified in ^{153}Gd from in-beam spectra of (α,xn) reactions. The level scheme is well accounted for by a simple model coupling an octupole vibration to the transitional core. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 10468, 10483, 10505, 10511, and 10560.

10542 (IPNO-1972, pp 5) DECAY OF ^{191}Hg AND ^{191}Au. Hoglund, A.; Berg, V.; Kilcher, P.; Jastrzebski, J. [nd]. (In French).

In 1972 annual report. (Paris-11 Univ., 91- Orsay (France). Inst. de Physique Nucleaire).

^{191}Au and ^{191}Pt level schemes were constructed after precise γ-γ, γ-e^-, e^--e^- coincidences and half-lives measurements. (auth)

10543 ANOMALOUS INFLUENCE OF THE ANGULAR MOMENTUM ON THE FISSION OF LIGHT NUCLEI BY PROTONS AND α PARTICLES. Ignatyuk, A.V.; Itkis, M.G.; Okolovich, V.N.; Smirenkin, G.N.; Tishin, A.S. JETP Lett. 21: No. 2, 74-75 (20 Jan 1975).

We present the results of measurements of the fission probability of the nuclei Po^{210}, Bi^{209}, Bi^{207}, Hg^{198}, Ir^{189}, and Os^{186} in the reactions (p, f) and (α, f). All six pairs of reactions reveal at low excitations a decrease of the fission probability on going from protons to α particles, in spite of the traditional notion that the fissility increases with increasing angular momentum. A theoretical interpretation of the observed anomalous effect is presented. (auth)

10544 SPIN AND PARITY OF THE 4.841-MeV LEVEL OF ^{208}Pb. Del Vecchio, R.; Freedman, S.; Garvey, G.T.; Oothoudt, M. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 34: No. 20, 1296-1297 (19 May 1975).

A level at 4.841 MeV in ^{208}Pb previously claimed to be 1^+ is shown to be 1^- by its large yield in inelastic α-particle scattering from ^{208}Pb. (auth)

10545 MOESSBAUER STUDIES OF ^{195}Pt FOR THE DETERMINATION OF g-FACTORS FOR THE 130 keV STATE. Wolbeck, B. Bonn; Univ. Bonn (1971). 59p. (In German). INIS.

Thesis.

Moessbauer investigations on ^{195}Pt were carried out. From the magnitude of the effect a branching ratio of the 130 keV transition followed of I(130)/I(131) = 4.91%. In a Pt-Fe-alloy as absorber the magnetic hyperfine interaction was observed. With the help of the 99-keV Moessbauer transition the interior magnetic field was determined at the nuclear place of platinum: H(int) = 1.274 MG. Thereby and by the measuring of the magnetic hyperfine spectrum of the 130-keV transition the g-factor of the 130-keV state could be determined to g(130 keV) = 0.35. (auth)

10546 HIGH-SPIN LEVEL SYSTEMATICS IN $^{186-194}$Pt AND ROTATION-ALIGNMENT COUPLING. Piiparinen, M.; Cunnane, J.C.; Daly, P.J. (Chemistry Department, Purdue University, West Lafayette, Indiana 47907); Dors, C.L.; Bernthal, F.M.; Khoo, T.L. Phys. Rev. Lett. 34: No. 17, 1110-1113 (28 Apr 1975).

Systematic investigations of the shape-transitional nuclei ^{186}Pt to ^{194}Pt by $(\alpha,xn\gamma)$ reactions have revealed a rich variety of high-spin structural phenomena, which can be qualitatively understood in terms of rotation-alignment coupling and the interplay between collective and single-particle excitation modes. Acute backbending in the positive-parity yrast sequences of ^{188,190,192,194}Pt is attributed to the intersection of rotation-aligned $(\nu i_{13/2}{}^{-2})$ and $(\pi h_{11/2}{}^{-2})$ bands with the ground bands. (auth)

10547 ROTATION ALIGNMENT IN ^{190}Pt AND ^{192}Pt. Funke, L.; Kemnitz, P.; Winter, G. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)); Hjorth, S. A.; Johnson, A.; Lindblad, T. (Research Institute for Physics, Stockholm 50, Sweden). Phys. Lett., B; 55: No. 5, 436-438(17 Mar 1975).

Levels with spins up to 18 (20) in the ground-state bands of ^{190}Pt and ^{192}Pt were observed. The very small energy spacing between the 12^+ and 10^+ levels in both nuclides is interpreted as a sudden decoupling of two i_{13} neutrons from the collective core. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 9662, 9712, 10505, 10516, and 10797.

10548 (BNWL-SA-5243) FISSION PRODUCT NUCLEAR DATA OBTAINED BY USE OF AN ON-LINE MASS SPECTROMETER. Reeder, P. L.; Wright, J. F.; Anderl, R. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 29 Jan 1975. Contract AT(45-1)-1830. 28p. (CONF-750303-64). Dep. NTIS $4.50.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A Spectrometer for On-Line Analysis of Radionuclides (SOLAR) has been installed at a 1 MW TRIGA reactor at Washington State University. Fission product ions from a combination target/ion source located within the thermal column are brought out to a 60^0 magnetic sector mass spectrometer. Surface ionization provides copious beams of Rb^+ and Cs^+ ions and less intense beams of Br^- and I^- ions with negligible contamination by other elements. About 40 fission product nuclides can thus be chemically and physically separated in times of less than 1 second. Past results on independent and cumulative fission yields along with measurements of half-lives of some very neutron-rich nuclides are presented. Current work on delayed-neutron emission probabilities and energy spectra of delayed neutrons from individual nuclides is described. (7 tables, 2 figures) (auth)

10549 (CEA-CONF-2972) DETERMINATION OF A COHERENT PARAMETER SET FOR COUPLED CHANNEL CALCULATIONS OF ^{238}U NEUTRON CROSS-SECTIONS FROM 10 keV TO 20 MeV. Lagrange, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1974. 12p. INIS.

From international symposium on neutron induced reactions; Smolenice, Czechoslovakia (1 Sep 1974).

Also presented at international school on nuclear physics. Predeal, Romania, 4-13 September 1974.

Since ^{238}U is a highly deformed nucleus, a deformed optical potential was used for neutron cross section calculations, with two sets of base states: $(0^+, 2^+)$ and $(0^+, 2^+, 4^+)$. In each case, the optical parameter set was chosen as to satisfy the following experimental constraints: the s- and p-wave strength functions, the potential scattering cross section at low energy and also the total cross section from 10 keV to 20 MeV. The results obtained are discussed. (FR)

10550 (IA-1301) NEUTRON CROSS SECTIONS FOR PLUTONIUM-238. Caner, M.; Yiftah, S. (Israel Atomic Energy Commission, Tel Aviv). Jul 1974. 58p. INIS.

An evaluation of ^{238}Pu neutron data was performed. All significant cross sections in the neutron energy range 10^{-3} to 15×10^6 eV were considered. The experimental data were complemented by spherical optical model and statistical theory calculations, and by systematics. The evaluated data were compared with those in the ENDF/B-III file. (auth)

10551 MEASUREMENT OF ALPHA, NEUTRON FISSION, AND CAPTURE CROSS SECTIONS FOR URANIUM-235 AND PLUTONIUM-239 FOR NEUTRON ENERGIES FROM 10 TO 80 keV. Kononov, V. N.; Poletaev, E. D.; Yurlov, B. D. At. Energ. (USSR); 38: No. 2, 83-86(Feb 1975). (In Russian).

The values of alpha, neutron fission and capture cross sections of ^{235}U and ^{239}Pu were measured for incident neutron energies between 10 and 80 keV using a pulsed Van-de-Graaff accelerator as the neutron source and the time-of-flight technique. Capture and fission events were detected by means of a large liquid scintillator tank loaded with cadmium. Alpha cross sections were measured absolutely and fission cross sections were measured relative to the cross section of the reaction $^{10}B(n, \alpha\gamma)$. The resolution of the measurements was 20 ns/m. The obtained results for alpha are accurate within 10 + 12% and are in reasonable agreement with earlier results and other published data. (3 figures, 3 tables, 15 references.) (auth)

10552 NUCLEAR CHARGE DISTRIBUTIONS IN THE ISOBARS 92 TO 100 RESULTING FROM THERMAL NEUTRON FISSION OF URANIUM-235. Siegert, G.; Greif, J.; Wollnik, H.; Fiedler, G.; Decker, R.; Asghar, M.; Bailleul, G.; Bocquet, J.P.; Gautheron, J.P.; Schrader, H.; Armbruster, P.; Ewald, H. (Institut Laue-Langevin, F-38042 Grenoble Cédex, France). Phys. Rev. Lett. 34: No. 16, 1034-1036 (21 Apr 1975).

The nuclear charge distribution of fission products from $^{235}U(n_{th},f)$ is determined for the isobaric chains 92 to 100. The results were obtained from the energy loss of monoisobaric and monoenergetic fission products in a ΔE Si surface-barrier detector. The odd-even effect is found also in the mass chains reported here for the first time, revealing an approximately sinusoidal variation of the charge distribution width with mass. (auth)

10553 NEUTRON EMISSION FROM THE SPONTANEOUS FISSION OF CALIFORNIUM 252. Hipp, H. Tuebingen, Ger.; Univ. Tuebingen (2973). 27p. (In German). INIS.

Thesis.

The neutron emission from the spontaneous fission of ^{252}Cf is experimentally investigated in dependence from the fragment mass and the kinetic energy. The number of neutrons emitted is evaluated indirectly from the kinetic data of the fragments using the conservation laws for momentum energy and mass number. (auth)

10554 FISSION LIFETIMES MEASURED BY CRYSTAL BLOCKING OF FRAGMENTS FROM $^{238}U(n,f)$ REACTIONS. Andersen, J. U.; Nielsen, K. O.; Skak-Nielsen, J. (Aarhus Univ. (Denmark)); Hellborg, R. (Lund Univ. (Sweden). Fysiska Institutionen); Prasad, K. G. (Tata Inst. of Fundamental Research, Bombay (India)). Nucl. Phys., A; 241: No. 2, 317-331 (7 Apr 1975).

The lifetime of ^{239}U compound nuclei formed in $^{238}U(n,f)$ reactions was measured at three neutron energies, 1.7, 2.3, and 3.6 MeV, by the crystal-blocking lifetime technique. The results are $\tau = 300 \pm 70$ as (1.7 MeV), $\tau = 200 \pm 55$ as (2.3 MeV), and $\tau < 100$ as (3.6 MeV). For the two lower energies, the axial and planar methods for lifetime extraction were compared, and the results are in reasonable agreement. The lifetimes are combined with measured values of the fission probability $P_f = \Gamma_f / \Gamma$ to obtain the partial widths for fission, Γ_f, and for neutron emission, Γ_n. These are in turn compared with theoretical estimates. (auth)

Nuclear Theory

Refer also to abstracts 9749, 10031, 10037, 10255, and 10290.

10555 (CEA-CONF-2967) A TWO-CENTRE BASIS SUITABLE FOR HARTREE–FOCK CALCULATIONS. Berger, J. F.; Gogny, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1974. 5p. INIS.

From international symposium on neutron induced reactions; Smolenice, Czechoslovakia (1 Sep 1974).

Starting from two sets of harmonic oscillator functions a finite orthogonal basis useful for nuclear structure studies based on two-centre models was constructed. Such a two-centre basis shows the same features as the well-known one obtained from a two-centre harmonic oscillator potential. In particular it is an appropriate basis for the description of very deformed nuclear systems including two separate fragments. The main advantage of the method orginates in the standard properties of the harmonic oscillator functions used. This is of special interest in Hartree–Fock calculations of heavy nuclei, which involve a very large number of two-body matrix elements. In fact, the techniques developed for the one-centre oscillator basis can easily be generalized. (FR)

10556 (CONF-750506-1) SPALLATION REACTIONS: CALCULATIONS. Bertini, H. W. (Oak Ridge National Lab., Tenn. (USA)). 1975. 31p. Dep. NTIS $4.75.

From symposium on spallation nuclear reactions and their applications in astrophysics and radiotherapy; Philadelphia, Pennsylvania, USA (2 May 1975).

Current methods for calculating spallation reactions over various energy ranges are described and evaluated. Recent semi-empirical fits to existing data will probably yield the most accurate predictions for these reactions in general. However, if the products in question have binding energies appreciably different from their isotropic neighbors and if the cross section is approximately 30 mb or larger, then the intranuclear-cascade-evaporation approach is probably better suited. (6 tables, 12 figures, 34 references) (auth)

10557 (FEI-472) ESTIMATE OF THE CONTRIBUTIONS OF THE STRAIGHT PROCESS OF SPECTRA IN THE INELASTIC SCATTERING OF NEUTRONS. Luk'yanov, A. A.; Sal'nikov, O. A.; Saorykin, E. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obnisk. Fiziko-Ehnergeticheskij Inst.). 1974. 22p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

In spectra of inelastically scattered neutrons obtained experimentally for a number of nuclei at neutron bombarding energies of 9.1 and 14.36 MeV the most characteristic differences in the energy and angular dependencies from the evaporation model spectrum are interpreted as a contribution of direct inelastic scattering on separate target nucleons. A simple scheme is developed for qualitatively estimating this contribution to the twofold differential cross sections of inelastic scattering, measured with a wide experimental resolution. As a result of the analysis it was possible to obtain identical nuclear temperatures T over all angles, to estimate the contribution of the direct process to the total cross sections of inelastic scattering, and to give a qualitative explanation of the observed asymmetry of the angular distribution of inelastically scattered neutrons within the framework of the shell model. (2 figures) (SJR)

10558 (INR-1450/7/PL/C) ON THE EXPANSION OF NUCLEAR ROTATIONAL ENERGY IN POWERS OF ANGULAR VELOCITY OF ROTATION. Abrasimov, V.; Krumlinde, J.; Szymanski, Z. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 23p. INIS.

The coefficients α, β, γ and δ appearing in the expansion of the nuclear rotational energy in powers of the square of angular velocity are calculated by a microscopic method. Two simplified nuclear two level models are used: with use of the BCS approximation, and based on the exact diagonalization of the nuclear rotational Hamiltonian including the short-range pairing forces acting between the nucleons. (auth)

10559 (JINR-P1-8402) SUPERSTRONG MAGNETIC FIELDS APPLIED TO PHOTOEMULSION INVESTIGATIONS AT HIGH ENERGIES. Tolstov, K. D.; Shabratova, G. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The prospects are presented for the application of pulsed magnetic fields with an intensity of about 10^6 Oe to the investigations of the interaction of particles and high-energy nuclei with nuclei using photoemulsions. (1 figure, 6 tables) (auth)

10560 (JINR-R-4-7499) SEMI-MICROSCOPIC CALCULATION OF THE LEVEL DENSITY IN SPHERICAL NUCLEI. Solov Solov'ev, V. G.; Stoyanov, Ch.; Vdovin, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 38 pp. (In Russian). INIS.

By direct calculation of the number of states with consideration of collective vibrational excitation, the densities of states with neutron bonding energies B_n were calculated for 90 spherical

nuclei in the interval $50 \leq A \leq 205$. The effect of the nuclear vibration on the state densities was studied. The dependence of the density of states on the excitation energy, spin, and parity was investigated. The fluctuations of density in light and near-magic nuclei were discussed. (INIS)

10561 (KFK-2060) OPTICAL MODEL ANALYSIS OF NEUTRON CROSS SECTIONS AND STRENGTH FUNCTIONS. Newstead, C. M.; Cierjacks, S. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Mar 1974. 19p. (CONF-740320-10). Dep. NTIS (US Sales Only) $4.00.

From EANDC topical meeting; Tokyo, Japan (27 Mar 1974).

Current problems met in the attempt to interpret fast neutron total cross sections with spherical and coupled channels optical model calculations are discussed. The energy dependence of the real and imaginary potential strengths is considered and progress in fitting neutron total cross sections over a wide energy range is discussed. Fluctuations in the strength of the imaginary potential are investigated in terms of the s-and p-wave neutron strength function. The role of strength function systematics in aiding study of the optical potential is developed. The implications, of energy and mass dependences of the optical potential for neutron data predictions are outlined. (7 figures, 1 table) (auth)

10562 (LA-UR-75-582) QUANTITATIVE ASSESSMENT OF CTR CROSS SECTION NEEDS. Gerstl, S. A. W.; Dudziak, D. J.; Muir, D. W. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 13p. (CONF-750303-50). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A computational method to quantitatively determine cross section requirements is described and applied to a particular CTR design project. In order to provide a rational basis for the priorities assigned to new cross section measurements or evaluations, this method includes a quantitative assessment of the uncertainty of currently available data, the sensitivity of important nuclear design parameters to selected cross sections, and the accuracy desired in predicting nuclear design parameters. Perturbation theory is used to combine estimated cross section uncertainties with calculated sensitivities to determine the variance of any nuclear design parameter of interest. Selected computational results are presented for a model of the Tokamak Fusion Test Reactor. (4 figures, 4 tables) (auth)

10563 (ORO-4856-6) COMPARISON OF HARTREE-FOCK AND ENERGY DENSITY FORMALISM CALCULATIONS FOR SOME SPHERICAL NUCLEI. Dworzecka, M.; Moszkowski, S. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Apr 1975 30p. Dep. NTIS $4.50.

The parameters of the nuclear droplet model, introduced by Myers and Swiatecki, and extension of the conventional liquid drop model, to higher powers of A/sup -⅓/ are calculated. Hartree-Fock calculations are done for a large number of spherical nuclei, using the Modified Delta Interaction (MDI) version of the Skyrme interaction, and an average is taken over shell structure by making a least square fit to the Hartree-Fock energies. A comparison is made of the shell averaged HF results with those obtained by using a simple version of the energy density formalism developed by Brueckner, Lombard, and others. Assuming the simple form of the energy density first introduced by Skyrme for N equals Z nuclei, the total energy is minimized with respect to the actual density and diffuseness, subject to the constraint of fixed number of particles. Detailed comparison with the HF results were made for two A equals 100 nuclei with Z equals 50 and 40. It is found that the droplet model energies calculated either exactly (numerically) or analytically by expansion of the radial integrals in powers of (a/R) (a equals diffuseness, R equals half density radius for a Fermi density), are in good agreement with the shell averaged HF results although there is some uncertainty in the latter. However, the central density is too small by about 10 percent for the cases considered. Yet, for the case Z equals 40, A equals 100, the ratio of neutron and proton densities is close to the Hartree-Fock value. Thus, the energy density formalism can reproduce quite closely the results of more complicated Hartree-Fock calculations. (2 figures, 4 tables) (auth)

10564 (RT/FI-74-36) CERBERO: A FORTRAN PROGRAMME FOR THE CALCULATION OF NUCLEAR REACTION CROSS SECTIONS. Fabbri, F.; Reffo, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1974. 34p. INIS.

The CERBERO code can calculate a complete consistent set of binary cross sections on the basis of the optical model and of the statistical model. Only spherical local potentials are allowed. (auth)

10565 (WANL-TMI-903) HIC, PROGRAM FOR CALCULATION OF NEUTRON HEATING, CAPTURE AND INELASTIC SCATTERING RATES FROM MULTIGROUP DIFFUSION THEORY FLUXES. Nassano, R. N.; Heiser, P. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 23 Dec 1963. 114p. Dep. NTIS $8.75.

HIC (heating, inelastic, capture) is a Fortran II program written for the IBM-7090. The program utilizes 51 group neutron fluxes from diffusion theory in calculation of neutron heating rates, fast neutron dose rates, neutron capture gamma rates, gamma rays from inelastic scattering, and fission density distributions. The HIC program may be linked directly to a 51 group P1MG program by means of a Fortran subprogram. This code is written for fourteen elements and isotopes: hydrogen, carbon, iron, nickel, niobium, aluminum, chromium, beryllium, titanium, boron - 10, lithium - 7, lithium - 6, uranium - 235 and 238. The user may use other than the 14 elements selected here by changing the parameters or the HIC card library. The makeup of this library is described in an Appendix. The physics of the code, the mathematical formulae, as well as input and output data for a sample problem are described. (auth)

10566 (ZFK-281) THEORY OF NUCLEAR REACTIONS. Ivanova, S. P. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jul 1974. 58p. (In Russian). Dep. NTIS (US Sales Only) $6.00.

The study of nuclear reactions can yield knowledge on the general laws of nature and data on the structure of the nucleus. These two aspects are examined in an examination of current theories of nuclear reactions. The topics discussed are the scattering matrix, diffraction model of the nucleus, model of the compound nucleus, decay of the compound nucleus, optical model of the nucleus, direct inelastic scattering, and deuteron stripping. (JSR)

10567 NUCLEAR REARRANGEMENT SCATTERING. II. Scattering of Composite Projectiles with Application to Deuteron Elastic Scattering, the Deuteron Optical Model, and Deuteron Stripping. Scheerbaum, R. R. (Texas A and M Univ., College Station); Shakin, C. M. Ann. Phys. (N. Y.); 89: No. 2, 299-358(Feb 1975).

Methods developed for the description of scattering from correlated nuclei and applied previously to the elastic scattering of nucleons, and to quasifree (p,2p) reactions, are extended to include the possibility of describing composite nuclear projectiles. These methods are then applied to obtain a unified description of deuteron scattering. We consider the elastic and the stripping final channels explicitly. The correlated structure of the deuteron and of the target nucleus and the influence of these correlations on the off-shell character of the appropriate channel interactions are taken fully into account. So too are the Pauli and exchange effects due to the identity of the nucleons of the deuteron and the target nucleus. The theory leads to a two-potential formulation for the optical potential for deuteron elastic scattering. The correct energy dependence of these potentials is explicitly exhibited. Deuteron stripping is also discussed in some detail within the context of our formalism. We obtain the lowest-order expression for the stripping amplitude and we indicate a certain class of corrections to this lowest-order term. The various approximations which are necessary to make contact with phenomenological distorted-wave treatments are indicated. (4 figures, 1 table) (auth)

10568 GENERATOR COORDINATE THEORY OF NUCLEAR REACTIONS. Giraud, B. (CEN de Saclay, Paris); LeTourneux, J.; Osnes, E. Ann. Phys. (N. Y.); 89: No. 2, 359-392(Feb 1975).

The generator coordinate formalism is generalized to incorporate optical potentials, coupled waves, and a distorted-wave approximation. An estimate of the importance of recoil is proposed. An analytical illustrative example related to the generator coordinate DWBA is given. (1 figure) (auth)

10569 LEVEL DENSITY FLUCTUATIONS AND RANDOM MATRIX THEORY. Bohigas, O.; Giannoni, M. J. (Inst. de Physique Nucleaire, Orsay, France). Ann. Phys. (N. Y.); 89: No. 2, 393-422(Feb 1975).

The main purpose of this work is to elucidate whether there are significant differences in the local fluctuation properties between two-body (TBRE) and orthogonal (OE) ensembles of random matrices. Emphasis is put on the validity of ergodic properties, and results obtained by numerical means are discussed from that point of view. Spectral and ensemble averaging procedures are compared. All the local properties studied show compatibility between TBRE and OE results, and no significant evidence of inconsistency of theoretical predictions and experimental data is found. (6 figures, 11 tables, 34 references) (auth)

10570 ABNORMAL NUCLEAR STATES AND VACUUM EXCITATION. Lee, T.D. (Physics Department, Columbia University, New York, New York 10027). Rev. Mod. Phys. 47: No. 2, 267-275 (Apr 1975).

We examine the theoretical possibility that at high densities there may exist a new type of nuclear state in which the nucleon mass is either zero or nearly zero. The related phenomenon of vacuum excitation is also discussed. (auth)

10571 PION CONDENSATION IN NUCLEI AND *l*-FORBIDDEN *M*1 TRANSITIONS. Sapershtein, E.E.; Troitskii, M.A. JETP Lett. 21: No. 2, 62-63 (20 Jan 1975).

A possibility is indicated of explaining the enhancement of the *l*-forbidden *M*1 transitions on account of the presence of pion condensation in the nuclei. (auth)

10572 THE EFFECT OF A HEXADECAPOLE TERM OF THE RESIDUAL INTERACTION IN EVEN DEFORMED NUCLEI. Silvestre-Brac, B.; Piepenbring, R. (Institut des Sciences Nucleaires, 38-Grenoble (France)). Z. Phys., A.; 272: No. 1, 89-98(1975).

To explain some experimental properties of even deformed nuclei a two-separable component force is needed. Instead of using the sophisticated forces generally introduced in the literature, one simply takes into account the hexadecapole term of the multipole expansion of the residual interaction. Using then simple R. P. A. technics one can explain a second 0^+ state below the gap. The rather weak B(E2) values from the first excited 0^+ state to members of the ground state band in the middle of the rare earth region are also well described. (auth)

10573 Q-VALUES AND EXCITATION FUNCTIONS OF NUCLEAR REACTIONS. b. Excitation Functions for Charged-Particle Induced Nuclear Reactions. Keller, K. A.; Lange, J.; Muenzel, H.; Pfennig, G. Landolt-Boernstein. Zahlenwerte und Funktionen aus Naturwissenschaften und Technik. Neue Serie. Berlin, F. R. Germany; Springer (1973). 493p. (In German, English).

The volume contains about 1,800 experimentally determined excitation functions for nuclear reactions of charged projectiles (p up to ^{40}Ar) with a great number of target nuclides (^{1}H up to ^{96}Cf) at projectiles energies up to 200 MeV. The excitation functions are presented in graphs which are supplemented by a table with characteristic data. (auth)

10574 SEMICLASSICAL THEORY OF A JOSEPHSON EFFECT IN NUCLEAR REACTIONS IN REFERENCE TO COULOMB-EXCITED VIBRATIONS. Winnik, S. L. Munich; Technische Univ. (1974). 68p. (In German). INIS.

Thesis.

The ground and the first excited vibrational states of spherical superfluid nuclei are described by a pair-quadrupole-quadrupole force in the framework of quasi-spin formalism. Similar to the Tamm-Dancoff method the space of states is spanned by states of seniority number 0 and 2. The interaction between the nuclei is given by an operator which describes the pair transfer and by the Coulomb interaction up to monopole-quadrupole terms. For the systems ^{120}Sn → ^{120}Sn and ^{122}Sn → ^{124}Sn numerical results are given. The probability for multiple pair transfer shows as function of the kinetic energy qualitatively the same oscillating behavior for both systems. By Coulomb interaction excited vibrational states are populated. Also these channels in which one of the scattering nuclei is excited show the oscillations in the pair transfer probability characteristic for the Josephson effect. Coulomb excitation counters the pair transfer, however. (GE)

10575 CHIRAL FIELD THEORIES AND THREE-BODY FORCES IN NUCLEI. Barshay, S.; Brown, G.E. (Department of Physics and Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794). Phys. Rev. Lett. 34: No. 17, 1106-1109 (28 Apr 1975).

We obtain the elementary results of a field theory of forces in nuclei due to a scalar meson, treated classically, by means of a simple Hartree treatment. This simple method makes possible estimates of the ratio of the binding energy per nucleon from three-body forces to that from two-body forces. In particular, we estimate a new type of three-body force that occurs in the σ model. (auth)

10576 ESTIMATE OF THE ABSOLUTE VALUE OF THE CROSS SECTION FOR INELASTIC DOUBLE CHARGE EXCHANGE ON NUCLEI. Kolybasov, V.M. (Institute of Theoretical and Experimental Physics). JETP Lett. 21: No. 1, 39-40 (5 Jan 1975).

The influence of the instability of the isobar on the absolute value of the cross section and on the character of the distribution with respect to the missing mass (relative to the emitted pion) is estimated at different momentum transfers for the double-charge-exchange mechanism that includes the production of the virtual isobar Δ (1236). (auth)

10577 SEMICLASSICAL SCATTERING AMPLITUDE IN THE COMPLEX LAMBDA-PLANE. Rowley, N.; Marty, C. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Phys. Lett., B; 55: No. 5, 430-432(17 Mar 1975).

The stationary phase evaluation of the semiclassical scattering amplitude is replaced by the saddle-point method. In a simple model this allows the interpretation of forward-angle oscillations in terms of a pole of the parametrized S-matrix. (auth)

10578 MECHANISM FOR THE REMOVAL OF CLUSTERS FROM NUCLEI FOLLOWING ABSORPTION OF STOPPED K^-. Barshay, S. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Phys. Lett., B; 55: No. 5, 457-458(17 Mar 1975).

The observation of the removal of alpha-particle-like and triton-like clusters from nuclei following the absorption of stopped K^- may indicate enhanced three-body forces between the hypercharge-zero baryon resonance, the Y_0^* (1405 MeV), and neighboring nucleons near the nuclear surface. (auth)

10579 NUCLEON TRANSFER CROSS SECTIONS FOR MIXED ODD-A TARGETS. Thompson, R. C.; Ikeda, A.; Kleinheinz, P.; Sheline, R. K. (Florida State Univ., Tallahassee (USA). Dept. of Physics); Daly, P. J. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Chemistry). Phys. Lett., B; 55: No. 5, 447-449(17 Mar 1975).

The effect on single-nucleon transfer cross sections of Nilsson orbital admixtures in odd-A target states is considered. Explicit expressions for the population of the even-even ground-state band and two-quasiparticle bands are presented. A comparison with the results of the ^{189}Os (d,t)^{188}Os reaction is made. (auth)

10580 COHERENT AND INCOHERENT MULTIPLE PRODUCTION IN NUCLEI. Gottfried, K. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 79-95 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Current interpretations of incoherent and coherent multiparticle production from nuclear targets at high energies are reviewed. Particular emphasis is placed on the multiplicity and inclusive distributions observed at NAL and cosmic ray energies. It is demonstrated that the nuclear process is exceedingly sensitive to the very early stages of the underlying two-body collision, and that it therefore yields valuable information that cannot be obtained in collision with hydrogen. The astonishingly low multiplicities observed in complex nuclei are shown to be inconsistent with most models of the production process. A new model of the collision is proposed in which the local energy flux plays the dominant role. It provides a successful and parameter-free account of the data. (auth)

10581 NON-DIFFRACTIVE NUCLEAR PRODUCTION PROCESSES. Faeldt, G. (Lund Univ. (Sweden). Institutionen foer Teoretisk Fysik med Mekanik). pp 123-126 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The theory for a class of nuclear production processes where the underlying nucleon amplitudes vanish in the forward direction is reviewed. Both Coulomb and strong production processes are considered. (auth)

10582 A THEORY OF THE PION-NUCLEUS OPTICAL POTENTIAL. Cammarata, J. B.; Banerjee, M. K. (Maryland Univ., College Park (USA)). pp 195-197 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The role of pion-nucleus crossing in the construction of an optical potential is discussed, and it is shown that crossing has a significant effect on the cross sections and the elastic scattering wave functions of low energy pions. (auth)

10583 KINEMATICS AND OFF-ENERGY-SHELL EFFECTS IN MULTIPLE SCATTERING. Kujawski, E. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)); Lambert, E. (Neuchatel Univ. (Switzerland). Inst. de Physique). pp 188-190 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Work dealing with the question of what information about the nucleus or elementary interaction may be obtained from intermediate energy elastic nuclear scattering is reported: namely, the possibility of investigating two-body nuclear correlations and the off-energy-shell behavior of the projectile-nucleon interaction. (auth)

10584 AN APPROACH TO PION-NUCLEUS SCATTERING NEAR THE (3,3) RESONANCE. Barshay, S. (Niels Bohr Institutet, Copenhagen (Denmark)); Rostokin, V. (Moskovskij

Inzhenerno-Fizicheskij Inst. (USSR)); Vagradov, G. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij); Brown, G. E. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). pp 198-199 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974). From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A new approach to pion-nucleus scattering near the first pion-nucleon resonance is developed which is based upon the modification of the pion Green function due to isobar-hole excitation in the nuclear medium. A zero in the inverse propagator at zero frequency signals a π^0 condensate, and it is noted that this possibility exists in neutron stars due to the attraction that may be provided by isobar-hole excitation when the nucleon density exceeds ~0.6 $(fm)^{-3}$. (auth)

10585 TOTAL MUON CAPTURE RATES, AVERAGE NEUTRINO ENERGY AND NUCLEAR STRUCTURE. Bernabeu, J. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 303-307 of Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A method of avoiding the uncertainty associated with the mean neutrino energy in the Primakoff closure approximation to muon capture rates is discussed. Energy weighted sum rules are used for the corrective terms which are involved. A near model independent discussion is then possible, and the total rates are shown to be a very sensitive tool for studying the nuclear structure of the target. The explicit form of the sum rule is given in terms of effective interaction matrix elements. A possible generalization to T = 0 nuclei is finally given. (auth)

10586 PION PRODUCTION FROM NUCLEI. Sternheim, M. M. (Massachusetts Univ., Amherst (USA)); Silbar, R. R. (Los Alamos Scientific Lab., N. Mex. (USA)). pp 282-284 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The π^+ production by protons from nuclei was calculated using a semiclassical model. The overall agreement with data at 740 MeV is quite good. Ambiguities arising from the nuclear corrections are found to be larger than the effects of moderate variations of the nuclear surface parameters. (auth)

10587 SINGLE PION PRODUCTION IN PROTON NUCLEUS COLLISIONS. Locher, M. P. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). pp 262-269 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Theoretical calculations in the context of the 185-MeV Uppsala experiment on (p,π) reactions into bound nuclear final states are reviewed. The evidence that the reaction mechanism at this energy is dominated by processes involving two or more nucleons is discussed. Standard DWBA is compared to treatments involving the two-particle dynamics explicitly. The high sensitivity of the (p,π) reaction to nuclear structure is demonstrated for a model involving intermediate NN* formation. Off-shell effects, multiple scattering, and the exclusion principle are discussed. (auth)

10588 HIGH MOMENTUM ANALYSIS OF THE STRUCTURE. Gillet, V. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Physique Nucleaire). pp 340-355 of Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

After a discussion of the momentum content of nuclear wave functions, a review is given of theoretical and experimental results of high energy inelastic coherent scattering of electrons and hadrons with respect to the information that may bring on the distribution of high momenta in nuclei, on nuclear structure, on intrinsic deformed states, and on nuclear clustering. (auth)

10589 NUCLEON DISTRIBUTION DEPENDENCE OF PROTON-NUCLEUS SCATTERING. Lombard, R. J. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire); Auger, J. P. (Orleans Univ., 45 (France). Lab. de Physique). pp 334-335 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Several kinds of nuclear densities, corresponding to different approaches to the nuclear many-body problem, are used to calculate elastic and inelastic proton-nucleus differential cross sections. (auth)

10590 QUASI-FREE SCATTERING AND NUCLEAR STRUCTURE. Maris, T. A. J. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Instituto de Fisica). pp 356-368 of Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Quasi-free proton-proton and electron-proton scattering are reviewed. Some recent developments and open problems are also discussed and a new type of quasi-free (p,2p) measurement is described. (auth)

10591 QUASIFREE SCATTERING ON CLUSTERING PARTICLES AND Q-VALUES. Cueer, P. (Centre National de la Recherche Scientifique, 67 – Strasbourg (France). Lab. de Physique Corpusculaire); Sakamoto, Y. (Frankfurt Univ. (F. R. Germany). Inst. fuer Kernphysik). pp 396-399 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

When the c.m. wave function of clustering particles has its oscillatory structure in the interior region, the asymptotic form of the wave function, which essentially depends on the binding energy of the clustering particles in the nucleus, accounts for the large parts of the cross section. (auth)

10592 MICROSCOPIC DESCRIPTION OF THE SPREADING AND DECAY OF HOLE STATES. Fritsch, W.; Lipperheide, R.; Wille, U. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kern- und Strahlenphysik). pp 391-395 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). Amsterdam; North-Holland Publishing Company (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

The structure of nuclear hole states is discussed within the spectral function concept. The quasi-particle approximation and fully microscopic treatments of the hole spectral function are reviewed. Results of recent microscopic finite-nucleus calculations are presented. (auth)

10593 EXACT COMPUTATION OF THE ZEEMAN EFFECT ON NUCLEAR QUADRUPOLE RESONANCE PROFILES FOR POWDERS (SPIN I = 3/2). Determination of the Asymmetry Parameter. Darville, J.; Gerard, A. (Departement de Physique Atomique et Moleculaire, Institut de Physique, Sart-Tilman, B-4000 par Liege I, Belgium). Comput. Phys. Commun.; 9: No. 3, 173-181 (Mar 1975).

The asymmetry parameter (η) of the electric-field gradient tensor is to be determined precisely, using powder samples. The shape of the Zeeman effect envelope reflects a typical structure due to η. The complete quadrupolar and Zeeman Hamiltonian is treated exactly. Gaussian, lorentzian or experimental line convolution of the Dirac profile, followed by derivation, gives the first derivative envelope shape, to be compared to experimental results. (auth)

10594 VALIDITY OF THE IMPULSE APPROXIMATION IN MESON-NUCLEUS SCATTERING. Myhrer, F. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). Nucl. Phys., A; 241: No. 3, 524-532 (14 Apr 1975).

An equation for the meson-bound-nucleon amplitude is derived which allows one to examine corrections to the impulse approximation. An approximation where only the nuclear ground-state energy is kept in the propagators is also commented on. In a model calculation the corrections to these approximations are found to be important at low energy. (auth)

10595 INELASTIC PION-NUCLEUS SCATTERING IN DISTORTED-WAVE IMPULSE APPROXIMATION. Hess, A. T.; Eisenberg, J. M. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Nucl. Phys., A; 241: No. 3, 493-510 (14 Apr 1975).

The inelastic scattering of pions was examined using the distorted-wave impulse approximation formalism, with full inclusion of nucleon spin and isospin variables for the transition operator. A one-particle-one-hole model was used to describe the nuclear excitations, comprising both low lying surface vibrations and higher energy giant resonance states. A numerical solution of the Klein–Gordon equation with an appropriate form for the pion–nucleus optical potential generated the distorted pion waves. Numerical results for the cross sections are presented and the relevant dynamic selection rules are discussed. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 9162, 9200, 9269, and 9980.

10596 (COM-74-11792) TRANSMISSION OF ELECTRONS THROUGH FOILS. Seltzer, S. M. (National Bureau of Standards, Washington, D. C. (USA). Center for Radiation Research). Apr 1974. 87p. (NBSIR-74-457). NTIS $4.75.

The transmission of electrons through foils has been studied by a Monte Carlo method. Cases involving electrons with energies from 50 KeV to 1 MeV normally incident on beryllium, mylar, aluminum, and titanium foils are considered. Good agreement with experimental results has been found for quantities such as the number transmission, the energy and angular distribution of the emergent electrons, and the spatial distribution of energy deposited in the foil. A comprehensive set of results has been generated for 100, 150, 200, 300 and 400-KeV electrons incident on beryllium, mylar, aluminum, and titanium foils that are commonly used as vacuum windows in conjunction with low energy electron accelerators. Quantities given are the electron number and energy transmission and reflection, the energy absorbed, and the energy and angular distribution of the transmitted electrons. (GRA)

10597 (COO-1671-54) BEVALAC EXPERIMENTS SUGGESTED BY TRACK THEORY. Katz, R. (Nebraska Univ., Lincoln (USA)). [nd]. 39p. (CONF-731156-1). Dep. NTIS $5.00.

From conference on heavy ion research in radiological physics and radiation chemistry with bevalac ions; Berkeley, California, USA (1 Nov 1973).

Track structure theory is discussed for detectors having different interactive element size and different metastable lifetimes, which can affect the dose rate dependent response of the detector. A group of experiments is proposed to be done on the Bevalac accelerator to improve or test track structure theory, and to improve the quality of engineering and of detector theory through a reduction in the uncertainty of the fitted parameters. (GMT)

10598 (INR-1452/18/PP/B) HEATING OF A HALF-SPACE BY A BEAM. Madejski, J. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 36p. (In Polish). INIS.

Temperature distributions have been found for the following cases: non-transparent half-space; non-scattering half-space with linear absorption within the body; linearly absorbing and scattering half-space. (auth)

10599 (SC-DR-71-0715) IMPROVEMENTS IN THE CHART D RADIATION-HYDRODYNAMIC CODE IV: USER AID PROGRAMS. Thompson, S. L.; Lauson, H. S. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 62p. Dep. NTIS $6.25.

Several user aid programs concerning the CHART D radiation-hydrodynamic code are discussed. Input instructions and sample card decks are included. Both the CDC 6600 and the PDP 10 are employed. (auth)

10600 STOPPING POWER OF FAST CHANNELED PROTONS IN THE IMPACT PARAMETER TREATMENT OF ATOMIC COLLISIONS. Dettmann, K. (Kernforschungsanlage, Juelich, Ger.). pp 3-14 of Atomic Collisions in Solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

To account for channel stopping power, a tight binding approximation is proposed where the energy loss is calculated for individual inelastic collisions of the protons with single crystal atoms. The theory is given and calculations are done for 4-MeV channeled protons along the major axes in silicon and germanium. The results are compared with experimental data with good agreement. (6 figures, 8 references) (GHT)

10601 Z_1 OSCILLATIONS IN ELECTRONIC STOPPING. Briggs, J. S.; Pathak, A. P. (Atomic Energy Research Establishment, Harwell, Eng.). pp 15-23 of Atomic Collisions in Solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

An expression for the energy loss cross section of a particle of mass m_1 and velocity v_1 colliding with particles of mass m_2 having a distribution of velocities v_2 is obtained. The energy loss cross section is proportional to the momentum transfer cross-section which depends upon the elastic scattering intensity in the target-projectile center-of-mass system. When applied to the scattering of electrons by incident atoms moving at velocities v_1 approximately v_2 the momentum transfer cross section shows strong oscillations with Z_1 in the same regions as those observed in the electronic stopping power. These oscillations are connected with the shell structure of the periodic table by an analysis of the phase shift induced in the electron wavefunctions of different angular momentum. By considering the Coulomb scattering from a bare incident particle, the connection with other theories of stopping, when v_1 much less than v_2 and v_1 much greater than v_2 respectively, is established. (auth)

10602 Z_1^3-DEPENDENT STOPPING POWER AND RANGE CONTRIBUTIONS. Ashley, J. C. (Oak Ridge National Lab., TN); Ritchie, R. H.; Brandt, W. pp 25-33 of Atomic collisions in solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The stopping power of a target composed of atoms with atomic number Z_2, for a projectile of charge Z, e and velocity v_1, depends in the first Born approximation on the projectile charge as $(Z_1e)^2$. This theory is extended to include the $(Z_1e)^3$ dependence in a classical treatment which is equivalent to a second Born approximation. Results are shown and compared with experimental data for pi^+ and pi^- collisions with tantalum and aluminum targets, and for proton collisions with calcium and copper targets. (4 figures) (GHT)

10603 DEPTH DISTRIBUTION OF DAMAGE DUE TO IONIZATION. Winterbon, K. B. (Atomic Energy of Canada Ltd., Chalk River, Ontario). pp 35-46 of Atomic Collisions in Solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The depth distribution of the damage due to ionization caused by heavy ion irradiation is calculated by the transport equation method previously used for the calculation of range and damage distributions. The calculation differs from Brice's chiefly in that it allows for the transport of energy by recoils away from the primary projectile path. Like the damage distribution, it should be more accurate than Brice's at low energies. It is found that a power-law limit of the ionization distribution can be constructed; thus one may take advantage of the simple scaling properties of power-law distributions. The importance of energy transport by recoils is examined for both ionization and damage distributions. A qualitative distinction between the ionization distribution and range or damage distributions is that the ionization distribution is discontinuous at the target surface. (This refers to the infinite target of the calculations, where the "surface" is merely a plane at which ion motion starts.) The differential-equation method of obtaining distributions from moments is generalized to allow inclusion of this discontinuity. (auth)

10604 ELECTRONIC STOPPING POWER IN ALKALI HALIDES BY MEANS OF COLOR CENTER PROFILES. Perez, A.; Thevenard, P.; Dupuy, C. H. S. (Univ. Claude Bernard, Villeurbanne, France). pp 47-56 of Atomic Collisions in Solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

F-center profiles created in LiF with 56-MeV alpha-particles and 28-MeV deuterons are obtained at room temperature by an optical method using a microspectrophotometer. These profiles are in a good agreement with the calculated electronic stopping power but a departure from linearity above 10^{14} MeV/cm^3 is observed. A saturation effect related to the dose is also observed and the F-center production is slightly lower, in the case of samples irradiated in the (110) direction, than in the (100) one. Taking into account the interaction tubes with F-centers, F-aggregate centers and cationic defects, we can give an interpretation of our results. (8 figures) (auth)

10605 VELOCITY DEPENDENCE OF THE STOPPING POWER OF CHANNELED IODINE IONS. Moak, C. D.; Appleton, B. R.; Biggerstaff, J. A.; Datz, S.; Noggle, T. S. (Oak Ridge National Lab., TN). pp 57-62 of Atomic Collisions in Solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

Recent measurements of uranium ion stopping powers in the energy range 30-90 MeV are presented along with earlier data for bromine and iodine ions. The results are compared with theoretical predictions of Lindhard, Scharff and Schiott, and of Firsov. The data indicate the stopping powers follow S/sub e/ equals a + bE/sup 1/2/ rather than S/sub e/ equals K/sup 1/2/ as predicted by Lindhard and Firsov. The date for iodine ions suggest that, below 21.6 MeV, there is a velocity region where the stopping power curve is more complex and additions to the theory must be made for this range. (5 figures) (GHT)

10606 CHARGE STATE DEPENDENCE OF STOPPING POWER FOR OXYGEN IONS CHANNELED IN SILVER. Datz, S.; Appleton, B. R.; Biggerstaff, J. A.; Brown, M. D.; Krause, H. F.; Moak, C. D.; Noggle, T. S. (Oak Ridge National Lab., TN). pp 63-73 of Atomic Collisions in Solids, Vol. 1, Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids, Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

In previous work it was shown that electron capture and loss cross sections for 30-40 MeV O ions in Au channels were small enough (approximately 10^{-19} cm^2) to preclude charge state equilibrium in crystals 1 mu m thick. In fact, a large fraction of charges 8+ and 7+ passed through the crystal without any charge exchange. In this work it is shown that similar conditions obtained in Ag and the charge state dependence of the stopping power was measured for 27.8- and 40-MeV O ions in the [110] axial channel. It is found that, for those ions which do not undergo charge exchange, S equals kq^2 for charges 6+, 7+ and 8+. Other features observed in the energy spectra of the emergent ions are attributable to charge exchange in the crystal. Screening by Fermi electrons is expected to be the same for channeled and randomly penetrating ions. The results indicate that this screening is not effective in reducing the energy loss of the ion. (7 figures) (auth)

10607 TRANSMISSION ENERGY LOSS OF PROTONS CHANNELED IN THIN SILICON SINGLE CRYSTALS AT MEDIUM ENERGY. Della Mea, G. (Univ. of Padova, Italy); Drigo, A. V.; Lo Russo, S.; Mazzoldi, P.; Bentini, G. G. pp 75-76 of Atomic Collisions in Solids. Vol. 1, Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

Measurements of the stopping power of protons in silicon in random and channeling conditions (broken bracket 111 broken bracket direction) in the energy-range between 300 to 50 keV have been performed. The trend of the alpha-ratio has been reported. (auth)

10608 METHOD TO DETERMINE THE ENERGY LOSS OF HEAVY IONS IN SOLIDS. Schmidt-Boecking, H.; Ruehle, G.; Bethge, K. (Univ. Heidelberg). pp 77-83 of Atomic Collisions in Solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

A method is presented by which quick and reliable energy loss data for heavy ions in solids can be determined. If the elastic scattering cross section as a function of the energy is known, then it is possible to determine a larger energy range of the differential energy loss from one single measurement. (4 figures) (auth)

10609 THRESHOLD ENERGY FOR ATOMIC DISPLACEMENT IN RADIATION DAMAGE. Jung, P. (Kernforschungsanlage, Juelich, Ger). pp 87-104 of Atomic Collisions in Solids. Vol. 1, Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

Threshold energies for atomic displacement, as obtained from electron irradiation of solids, are reviewed and compared to other properties of these materials. Experimental problems as, e.g., influence of impurities are discussed. Results on the dependence of threshold energy on irradiation direction and irradiation temperature are given. (auth)

10610 DIRECTIONAL DEPENDENCE OF THE DISPLACEMENT ENERGY THRESHOLD FOR A FCC METAL. Beeler, J. R. Jr.; Beeler, M. F. (North Carolina State Univ., Raleigh). pp 105-114 of Atomic Collisions in Solids. Vol. 1, Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

Dynamical method computer experiments were used to map out the displacement energy threshold in a fcc metal as a function of the direction in which a primary knock-on atom is ejected from a lattice site. The displacement energy threshold for the [100] and [110] directions was about 22 eV and that for the [111] direction was 57 eV. A region of high displacement energy threshold was found in the interior of the stereographic triangle near the line between [111] and [110] poles. The largest threshold energy in this region was 70-75 eV. (auth)

10611 ENERGY DISSIPATION BY RANDOM COLLISIONS IN COMPOUND TARGET MATERIALS. Andersen, N.; Sigmund, P. (Oersted Inst., Copenhagen). pp 115-123 of Atomic Collisions in Solids. Vol. 1, Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

A brief account of calculations on the sharing of energy between the constituents of a polyatomic, in particular a binary medium, bombarded with heavy energetic ions is given. With a view at radiation damage and sputtering in composite targets, displacement efficiencies as a function of concentration, and particle fluxes as a function of energy and concentration for a few binary compounds are calculated. Pronounced deviation from stoichiometric behavior are found when the partial stopping powers of the constituents differ from each other because of different atomic number and mass. (auth)

10612 APPLICATION OF BOLTZMANN TRANSPORT EQUATIONS TO ION BOMBARDMENT OF SOLIDS. Sanders, J. B. (FOM-Inst. voor Atoom- en Molecuulfysica, Amsterdam). pp 125-139 of Atomic Collisions in Solids. Vol. 1, Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The state of energetic particles in solid materials, before the particles have reached equilibrium with their surroundings, is considered to determine the speed with which they lose their kinetic energy and the depth where they lose it. (GHT)

10613 INDICATION FOR AN IONIZATION DAMAGE PROCESS IN LIGHT ION IRRADIATION DAMAGE IN SILICON. Pabst, H. J.; Palmer, D. W. (Univ. of Sussex, Eng.). pp 141-157 of Atomic Collisions in Solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

Rutherford backscattering channeling experiments analyzed in the framework of single scattering theory, taking into account the effects of flux peaking, lattice location of defects (through dechanneling cross section), and number of scattering centers per defect, indicate defect introduction rates for 300 keV He^+ and 275 keV He^+ in the ratio 1 to 2 which is similar to the electronic stopping power ratio but differs considerably from Kinchin and Pease predictions (ratio 1 to 20). A multiple ionization damage process is proposed. (5 figures, 2 tables) (auth)

10614 RECOIL IMPLANTATION OF ^{18}O FROM SiO_2 BY HEAVY PROJECTILES. Moline, R. A.; Reutlinger, G. W.; North, J. C. (Bell Labs., Murray Hill, NJ). pp 159-173 of Atomic Collisions in Solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The recoil implantation yield of oxygen atoms recoiled from thin, ^{18}O enriched SiO_2 layers into silicon substrates has been studied using the $^{18}O(p,alpha)^{15}N$ nuclear reaction. Peak yield vs oxide thickness for 24- and 48-keV Kr ions is shown, and cross section for recoiling into the Si is given. The amount of ^{18}O which was backsputtered from the SiO_2 layers during the bombardment by Kr was determined, and shown to increase linearly with increasing SiO_2 thickness. The amount was nearly 10 times the recoil implantation yield. The primary knock-on yield from a $1/r^2$ potential, corrected for recoils caused by the primary knock-ons give excellent agreement to the yield vs oxide thickness data. Maximum energy carbon recoils from photoresist have a mean range much larger than the projectile. Thus, for high dose implantations, the desired photoresist thickness is best dictated by the range and range straggle of the recoils, not the projectiles. (7 figures) (auth)

10615 EFFECTS OF LATTICE DEFECTS ON DECHANNELING AND ON CHANNELED-PARTICLE DISTRIBUTION. Matsunami, N.; Itoh, N. (Nagoya Univ., Japan). pp 175-181 of Atomic Collisions in Solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The diffusion equation was applied to obtain the dechanneling caused by lattice defects in Si. It is shown that the predominant effect of defects on dechanneling for large surface concentration or large depth is the modification of the particle distribution in transverse energy and enhancement of dechanneling by lattice vibrations and electronic collisions. It is pointed out that this effect modifies considerably the depth profile of lattice defects extracted from backscattering experiments. (3 figures) (auth)

10616 COMPUTER SIMULATION OF THE MULTIPLE SCATTERING OF HIGH ENERGY HEAVY IONS IN THIN FILMS. Guettner, K.; Muenzenberg, G. (Physikalisches Inst., Giessen, Ger.). pp 201-213 of Atomic Collisions in Solids. Vol. 1. Datz, S. (ed.). New York; Plenum Publishing Corp. (1975).

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

A Monte-Carlo method is applied to describe the multiple scattering of fast heavy particles (MeV-region) by amorphous metal films. Different potentials are fitted to a screened Coulomb potential supplying rather simple connections between impact parameter and deflection angle for the single interactions. The energy loss of the charged particles is taken into account. The calculations yield the angular and energy distribution of the scattered particles together with the percentage distribution of the complete particle histories. The results are compared to experimental multiple scattering distributions of fission fragments in thin films. Furthermore differences and agreement concerning other theoretical results are discussed. As an example for the further application of the computational program, the scattering of high-energy ions (4 MeV/nucleon) by an edge-shaped slit is calculated. (auth)

10617 NUMERICAL SIMULATION OF RANGE AND BACKSCATTERING FOR keV PROTONS INCIDENT ON RANDOM TARGETS. Robinson, J. E.; Agamy, S. (McMaster Univ., Hamilton, Ontario). pp 215-224 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). CONF-730958-P1.

Using a Monte-Carlo technique, projected range distributions and backscattering coefficients have been calculated for keV protons normally incident on heavy targets. For an incident reduced energy range of 1 less than epsilon $_0$ less than 20, both the projected range distributions and backscattering coefficients have been found to be in good agreement with a third order Edgeworth range approximation. Backscattered energy and angular distributions have also been calculated and are compared to available theoretical and experimental data. (4 figs.) (auth)

10618 COMPUTER STUDIES OF REPLACEMENT SEQUENCES IN SOLIDS ASSOCIATED WITH ATOMIC DISPLACEMENT CASCADES. Holmes, D. K.; Robinson, M. T. (Oak Ridge National Lab., TN). pp 225-236 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). CONF-730958-P1.

Focussed sequences of replacement collisions have been studied, especially in association with radiation damage cascades. Radiation damage events are simulated using a computer program based on the binary collision approximation. The results are averaged over a complete set of initial directions of the primary knock-on atom for each primary energy to obtain quantities of physical interest for which the effects of replacement sequences may be made explicit. The calculations are compared with recent experimental results. (5 figs) (auth)

10619 MONTE CARLO SIMULATION OF BACKSCATTERING PHENOMENA. Hutchence, D. K.; Hontzeas, S. (Univ. of Saskatchewan, Regina, Canada). pp 251-258 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). CONF-730958-P1.

A Monte Carlo simulation program (BACKS) has been written in such a way as to be efficient for the generation of backscattering data for particle energies of approximately one keV to two MeV. The program is several thousand times as efficient as conventional programs in generating backscattering data at higher energies due to an information return analysis routine involving particle generation over selected sub-areas of the crystal face. The program takes into account energy losses and thermal motion. It allows for a nearly complete range of beam to crystal face angles. Most crystal forms can be used as well as crystals containing several different kinds of atoms. The data output includes a depth of information distribution energy loss spectrum, a number of collisions, distribution, and a backscattering pattern. Among the results obtained from the program is a quantitative prediction of a "classical" isotope effect. The results obtained also shed light on the effects of changing particle energy and crystal structure. (auth)

10620 ION SCREENING IN SOLIDS. Brandt, W. (New York Univ., NY). pp 261-288 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The behavior of charged particle beams passing through gaseous or solid targets is discussed with regard to charge states of the emerging beams. For an ion moving slowly in condensed matter, the charge, over distances comparable to the interatomic spacing in the target, is completely screened out and the projectile behaves like a neutral atom. At higher velocities, the dynamic screening is reduced and the effective ionic charge rises with velocity. When the velocity exceeds all electron orbital velocities in the projectile, the ion moves as a stripped point charge. Phenomena depending on the interior of the moving ion are discussed, and extensive comparison of the theory is made with various empirical results. (21 figs, 1 table, 37 refs) (GHT)

10621 SURF-RIDING ELECTRON STATES: POLARIZATION CHARGE DENSITY EFFECTS ASSOCIATED WITH HEAVY ION MOTIONS IN SOLIDS. Neelavathi, V. N.; Ritchie, R. H. (Oak Ridge National Lab.; TN). pp 289-293 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

Polarization waves as a consequence of charged particle energy loss to electrons in condensed media are discussed. These waves give rise to an oscillatory potential field extending behind and moving along with the particle. The possibility of the existence of quasi-stationary states of electrons in the minima of such a field and the possibility of electrons being captured into these surf-riding states are pointed out. (3 figs.) (GHT)

10622 ELECTRON PICK UP BY PROTONS EMERGING FROM SOLID SURFACES. Brandt, W. (New York Univ., NY); Sizmann, R. pp 305-306 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

Simple statistical approximations for the electron pick up processes in a wide range of proton energies are presented. When v_1 is comparable to the Fermi velocity but small compared to the electron velocities in the ion cores, approximately $Z_2/\sup \frac{2}{3}/v_0$, electron capture occurs in the tail of the electron distribution at the target surface (v_0 equals $2.2 \cdot 10^8$ cm/s). Under these conditions phi $_0$ is nearly the same for all surfaces and depends only on v_1. When v_1 approaches $Z_2/\sup \frac{2}{3}/v_0$, electron capture is influenced primarily by the interaction of the proton with the cores of the target atoms, but the relevant cross sections depend on Z_2 only as $Z_2/\sup \frac{1}{3}/$, and, thus phi $_0$ depends only slightly on Z_2. When v_1 exceeds $Z_2/\sup \frac{2}{3}/v_0$ and thus has exhausted the electron velocity space proffered to the proton beam by the target, double scattering processes are required for electron capture; phi $_0$ then depends on v_1 and strongly on Z_2, to order Z_2^3. In the light of the simplicity of the model underlying the considerations, theory and experiments are found to be in satisfactory agreement over the projectile energy range from E approximately 20 keV to E approximately 0.6 GeV, where phi $_0$ ranges from approximately 0.6 to approximately 10^{-12}. (auth)

10623 EXPERIMENTAL NEUTRAL CHARGE FRACTIONS IN PROTON BEAMS EMERGING FROM SOLIDS. Chateau-Thierry, A.; Gladieux, A. (Inst. National des Sciences et Techniques Nucleaires, Gif-sur-Yvette, France). pp 307-313 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

Experimental neutral fractions of proton beams emerging from foils of C, Al, Cr, Ni, and Au with energies in the range of 0.15

to 1.8 MeV are reported. In this range the neutral fraction varies from about 10 percent to about 0.01 percent, the high Z material producing slightly higher neutralization than the low Z foils. (auth)

10624 CHARGED FRACTION OF 5 keV TO 150 keV HYDROGEN ATOMS AFTER EMERGENCE FROM DIFFERENT METAL SURFACES. Behrisch, R.; Eckstein, W.; Meischner, P.; Scherzer, B. M. U.; Verbeek, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 315-329 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

The charged fraction of hydrogen atoms backscattered from Be, V, Cu, Nb, Mo, and Ta surfaces has been measured for energies between 5 keV and 150 keV and a wide range of angles of emergence. Only small differences are found for the charged fraction for different materials as long as the surface is covered by a layer of adsorbed impurities. There is, however, for most materials a change in the charged fraction due to annealing the target. For emergence energies above approximately 40 keV it is lower than for unannealed targets. An observed dependence of the charged fraction on the angle of emergence was generally just slightly above the experimental error. The measured results are compared with theoretical curves of Zaidins, Trubnikov et al., and Brandt and Sizmann. The best agreement is found with values given by Zaidins. The peculiarities observed at annealed surfaces are not predicted by theory. (10 figs, 29 refs) (auth)

10625 CHARGE NEUTRALIZATION OF MEDIUM ENERGY H AND ^{4}He IONS BACKSCATTERED FROM SOLID SURFACES, EFFECTS OF SURFACE CLEANING. Buck, T. M.; Feldman, L. C.; Wheatley, G. H. (Bell Labs., Murray Hill, NJ). pp 331-340 of Atomic Collisions in Solids. Vol. 1. Datz, S. (Ed.). New York; Plenum Publishing Corp. (1975).

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973). See CONF-730958-P1.

Experiments on charge states of H and ^{4}He backscattered from silicon and gold surfaces in the energy range 25-190 keV have been extended to investigate surface impurity and surface cleaning effects. The average charge state of ^{4}He scattered from iodine or gold impurities on silicon surfaces was close to that of ^{4}He scattered from silicon at the same energy. Argon bombardment cleaning of a gold surface caused substantial changes in neutralization for both ^{4}He and H, similar to results of Phillips in the case of hydrogen, and suggestive of more than one neutralization mechanism. The results are consistent with a neutralization step occurring outside the surface as the particle leaves. It is pointed out, however, that at low energies, 0.5-5 keV for ^{4}He, preferential neutralization of ions which penetrate beyond the surface has been inferred from electrostatic analyzer data. (auth)

10626 SCATTERING OF RESONANCE γ RAYS BY MOSAIC CRYSTALS EXHIBITING HYPERFINE SPLITTING OF NUCLEAR LEVELS. Perstnev, I.P.; Chukhovskii, F.N. Sov. Phys.—Solid State 16: No. 10, 1946-1950 (Apr 1975).

A theoretical analysis is made of the diffraction of nuclear resonance radiation by mosaic crystals exhibiting a hyperfine splitting of the nuclear levels. An analytic expression is obtained for the polarization tensor of the reflected wave. The interference and polarization phenomena resulting from the birefringence and nonorthogonality of the polarizations of normal waves in a crystal are analyzed. Estimates are obtained of the amplitude of the oscillations of the diffracted intensity as a function of the thickness of a crystal. The theory is compared with the experimental data on the symmetric Bragg reflection of nuclear resonance radiation from a crystal of hematite. (auth)

10627 X—RAY-INDUCED ELECTRON EMISSION FROM METALS. Dolan, K.W. (Sandia Laboratories, Livermore, California 94550). J. Appl. Phys. 46: No. 6, 2456-2463 (June 1975).

Energy and angular distributions of electrons (energies greater than 5 keV) emitted from metals irradiated by photons in the x-ray energy range were measured with a lithium-drifted silicon detector. The data presented here characterize electron emission distributions for normal photon incidence. They provide a systematic set of absolute distributions for quantitative comparisons to theoretical treatments of the combined photon and electron transport process. X-ray bremsstrahlung spectra with mean photon energies of 30 and 54 keV were used to induce electron emission from aluminum, copper, silver, and tantalum. Angular distributions for the higher-Z materials are found to be nearly cosine distributions in both the forward and backward emission directions, while the distributions for lower-Z materials deviate from a cosine distribution, tending to be more isotropic. Energy distributions are observed to change very little as a function of emission angle. Energy and angular distributions calculated by Monte Carlo and analytic techniques show good correlation with the measured distributions. Calculated forward and back (2π) emission efficiencies agree with experimental values within the uncertainties of these quantities ($\pm$15 to 20%). The generally good agreement between the experimental and theoretical results establishes the validity of the present techniques for calculating high-energy (greater than 5 keV) x-ray-induced electron emission from metals. (auth)

10628 ENERGY LOSS OF HEAVY IONS IN NUCLEAR COLLISIONS IN SILICON. Grob, J.J.; Grob, A.; Pape, A.; Siffert, P. (Centre de Recherches Nucléaires et Université Louis Pasteur, 67037 Strasbourg Cedex, France). Phys. Rev. B 11: No. 9, 3273-3279 (1 May 1975).

Heavy-ion channeling measurements performed in aligned surface-barrier detectors have allowed the determination of energy losses and straggling in nuclear collisions. Results are presented for $^{28}Si^+$ and $^{14}N^+$ in the 300–2000-keV region to illustrate the possibilities of this method. Comparisons of the theoretical and experimental data are made. A dependence of the energy partition between electronic and nuclear collisions on the atomic density along the ion path is demonstrated. (auth)

10629 RANGES OF IONS WITH $Z_1 \geq 54$ IN Al AND Al_2O_3. Andersen, H.H.; Bøttiger, J.; Jørgensen, H.W. (Institute of Physics, University of Aarhus, DK-8000 Aarhus C, Denmark). Appl. Phys. Lett. 26: No. 12, 678-679 (15 June 1975).

Ranges of Xe, Cs, Eu, Au, and Tl in polycrystalline Al and anodic Al_2O_3 at 75–100 keV are reported. Ranges in Al_2O_3 are found to be about 30% higher than predicted by the LSS theory for all Z_1. The shapes of the depth distributions are in excellent agreement with theoretical calculations. In Al, considerable deviations from theory for the most probable ranges and for the shapes of the distributions are found. These deviations are attributed to crystalline effects. (auth)

10630 TASKS AND METHODS OF DOSIMETRY. Taubert, R. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany)). PTB Mitt.; 84: No. 5, 301-312(Oct 1974). (In German).

Dosimetry is mainly founded on the third step of the sequence: radiation source → radiation field → primary interaction in the biological object → biological endpoint. However, the knowledge of the absorbed dose, e.g., absorbed energy/mass, does not suffice to draw definite conclusions about radiation risk or biological endpoints. In addition there has to be some knowledge about the radiation field and the relative biological effectiveness of the radiation. The main fields of application for dosimetry are radiation protection and radiation therapy. Special fields of interest are further the natural background radiation, radiation diagnosis, and radiation accidents. Out of the many radiation effects which might be used for dosimetric purposes the heat effect, the ionization effect, and chemical reactions induced by radiation are best suited for quantitative assessment. Basically a dosimeter measures the dose in the dosimeter material. To obtain the dose in biological material (tissue, bone) one must take into account certain material properties. The relevant transforming factors are the ratios of the mass stopping power in the dosimeter material and biological material or the corresponding ratios of the mass energy absorption coefficients. Today the uncertainties of dose determinations are not smaller than 1 to 2% for photon and electron dosimetry. In neutron dosimetry uncertainties of 10% seem to be realistic. (auth)

10631 R-MATRIX METHOD IN ATOMIC AND MOLECULAR PHYSICS. Burke, P. G. (Queen's Univ., Belfast). Comments At. Mol. Phys.; 4: No. 6, 157-162(1973).

Some recent applications of the R-matrix method in atomic and molecular physics are briefly reviewed. These include its role in the development of multichannel effective range theories, in the theory of frame transformations in electron-molecule collisions, and as an ab initio technique for the calculation of atomic polarizabilities, photoionization cross sections and electron-atom collision cross sections. (auth)

10632 EXPERIMENTALLY DETERMINED TISSUE AIR RATIOS AND SCATTER AIR RATIOS FOR COLLIMATED BEAMS OF 14 MeV NEUTRONS. Beach, J. L.; Kelsey, C. A. (Univ. of Wisconsin, Madison). Brit. J. Radiol.; 48: No. 566, 134-140(Feb 1975).

Tissue air ratios (TAR) and scatter air ratios (SAR) for collimated beams of 14 MeV neutrons were determined from depth dose curves measured in air and water using a tissue equivalent proportional counter. Central axis depth dose data were obtained as a function of field size and depth in a water phantom for an SSD of 125 cm. The collimator was composed of steel and polyethylene and was continuously variable from a 3 × 3 cm to a 20 × 20 cm field size at 125 cm SSD. The field scans for this collimator were flat within ±2% over 80% of the field dimension in air and were reduced to 20% of the central axis dose at 1·2 field radii in air. Relative depth dose data in air and phantom were measured with an accuracy of ±2% and were used for the TAR and SAR calcula-

tions. The resulting scatter air ratios for 14 MeV neutrons have roughly the same characteristics as ^{60}Co SAR, but are 60% larger at maximum build-up and reach that maximum at about 60% of the peak depth for ^{60}Co for all field sizes. The effects of collimator throat scatter on the central axis depth dose characteristics of this particular collimator design are discussed in detail using the measured tissue and scatter air ratios. (auth)

10633 SOME MEASUREMENTS OF SCATTERED RADIATION FROM AN ALDERSON PHANTOM FOR X-RAY BEAMS FROM 50 TO 200 kVp. Strickert, T.; Fosmark, H. (Statens Institutt for Straalehygiene, Oslo). Health Phys.; 28: No. 3, 209-212(Mar 1975).

Half value layer and exposure of 90° scattered radiation from an Alderson phantom have been measured at 1 m distance from the central ray of the primary beam. Results are presented for x-ray beams from 50 to 200 kV for two field sizes—one field adjusted to a 14 in. × 17 in. film size and the other was larger by a factor of 1.8. The rather high figures recently reported by Waggener et al. (Health Phys.; 24: 59 (1973)) for scattered radiation measured under similar conditions were not confirmed by the findings reported here, which are in agreement with results published by other workers. (auth)

10634 INELASTIC SCATTERING OF 80 keV ELECTRONS IN AMORPHOUS CARBON. Egerton, R. F. (Oxford Univ.). Phil. Mag.; 31: No. 1, 199-215(Jan 1975).

The cross section for inelastic scattering of 80 keV electrons in thin films of evaporated carbon has been measured as a function of energy loss (from 10 to 600 eV) and scattering angle (up to 0.1 rad). The energy-loss spectrum shows a broad peak around 24 eV, believed to arise mainly from plasmon oscillation of valence electrons. Losses between 50 and 280 eV are principally due to single interband transitions of the valence electrons, their intensity being proportional to (energy loss)$^{-r}$, with r in the range 4 to 4.5. Their angular distribution shows a broad peak within the range 20 to 50 mrad (dependent on the energy loss) which can be explained using either a wave-mechanical or a ballistic model. The cross-section for K-shell excitation (energy loss > 285 eV) was measured as a function of scattering angle; the results appear to be in good agreement with Bethe theory. Implications of inelastic scattering in transmission electron microscopy of carbon and organic materials are discussed with reference to chromatic aberration, beam divergence effects and the contribution to diffraction and Kikuchi patterns. (auth)

10635 ENERGY SPECTRA AND FRACTIONAL ABSORBED DOSE DISTRIBUTIONS IN LET FOR 14-MeV NEUTRONS. Fearon, T.; Maillie, H. D.; Kremer, W. A. (Rochester Univ., NY). Health Phys.; 28: No. 4, 443-449(Apr 1975).

Neutron energy spectra and fractional absorbed dose distributions in LET of a 14-MeV monoenergetic neutron beam have been obtained in a tissue equivalent liquid phantom. Threshold activation foils were used in the energy spectral determinations and a Rossi type proportional counter for the LET absorbed dose distributions. The effects of an inhomogeneity in the phantom were also examined. Results showed that the energy spectrum shifted to lower energies as a function of depth in the phantom and the absorbed dose distribution in LET shows modification with a decrease in the dose average LET. The inhomogeneous phantom caused a shift to lower energies in the energy spectrum and an increase of the dose average LET. (auth)

10636 PARTICLE CURRENT TO FLUENCE CONVERSION FOR INSTRUMENTS OF DETECTION AND FOR MONTE CARLO SIMULATED RADIATION TRANSPORT. Jones, T. D. (Oak Ridge National Lab., TN). Health Phys.; 28: No. 4, 451-458(Apr 1975).

Monte Carlo transport calculational analogs must often describe exposure situations involving specific numbers of source particles from isotropic or spatially dependent radiation fields being measured by non-spherically shaped detectors. "Particle fluence" is defined in terms of unperturbed field fluence and, in general, does not apply to particles incident on a detector. The objectives of this paper are: (1) to establish a sound basis for the selection of entry coordinates, (2) to predict the "incident particle fluence" from the description of the radiation source field incident on the detector and thus solve the "current to fluence" conversion problem and (3) to present an algorithm which can produce direction cosine parameters for particles from an isotropically incident field of radiation. (auth)

10637 NEUTRON DOSIMETRY IN MEDICINE AND BIOLOGY. Dennis, J. A. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 11, 9-14(Apr 1975).

The differences between the biological effects of neutrons and X-radiation are reviewed. In contrast to other radiations, the RBE of neutrons depends both on the type of neutron radiation and on the level of survival considered. Comparison of split doses of X-rays and neutrons demonstrates that cells can recover to a greater extent from irradiation with X-rays than from irradiation with neutrons. The oxygen enhancement ratio for neutrons shows little dependence on the type of neutron radiation or the level of effect, unlike RBE, and the values are very much smaller than those obtained for X-radiation. This last difference is most important in radiotherapy, since tumours are less likely to be protected against neutron radiation by the lack of oxygen resulting from poor blood supply. Treatment with neutron radiation would also be advantageous in those cases where the RBE for killing the tumour is greater than for killing healthy tissue. Neutron dose fractionation, where there is less recovery than with X-radiation, produces an apparent increase in RBE. Accurate dosimetry is essential in radiotherapy, and this raises special problems with neutrons. Different types of ionisation chambers and dosemeters used to measure the total sum of the absorbed dose due to neutrons and gamma rays, and of gamma radiation, are discussed, together with the uncertainties in the parameters in the equation relating the charge collected in the ionisation chamber to the neutron dose in tissue. Research at the National Radiation Protection Board is being directed towards a reduction in these uncertainties. (UK)

10638 EXTERNAL BREMSSTRAHLUNG SPECTRA EXCITED BY ^{32}P AND ^{35}S BETA RAYS IN DIFFERENT ELEMENTS. Babu, R. P.; Murty, K. N.; Murty, V. A. N. (Andhra Univ., Waltair, India). J. Phys., G. (London); 1: No. 3, 273-285(1 Apr 1975).

The spectral shapes of the external bremsstrahlung produced by ^{32}P and ^{35}S beta rays when they are completely absorbed in different elements such as carbon, aluminium, copper, silver, tin and lead are experimentally measured with a multichannel NaI(Tl) scintillation spectrometer along with a standard geometrical arrangement. After making all the necessary corrections, the final distributions are compared with the modified Bethe-Heitler theory. The experimental results are in excess over theory for high Z elements and this experimental excess over theory is found to increase with increasing nuclear mass and photon energy. (auth)

10639 RADIAL DISTRIBUTION OF REFLECTION AND TRANSMISSION OF SCATTERED GAMMA RAYS. Aminfar, H.; Razani, A. (Pahlavi Univ., Shiraz, Iran). Ann. Nucl. Sci. Eng.; 1: No. 11/12, 537-546(Nov 1974).

The lattice model concept of stochastic gamma ray transport is used to calculate the radial distributions of reflected and transmitted gamma rays on the faces of slabs of different thicknesses from a point collimated incident source. The radial distribution of scattered, reflected and transmitted spectra is calculated and the effect of incident angle, slab thickness, and annihilation radiation on iron and aluminum is investigated. Each collision in the medium is considered to be either a Compton scattering, a photoelectric absorption, or a pair production. To reduce variance, the absorption, point of first collision, and reflection and transmission after each collision are calculated analytically. These calculations are very easily done by associating a weight factor with the gamma rays at each lattice point. When pair production occurs, the history of one photon is followed with the statistical weight doubled. Using the model, a computer code is developed which is called PUGRT 1 (Pahlavi University Gamma Ray Transport 1). The results of this code are found to be in good agreement with other calculations and with experimental results on iron and aluminum. (auth)

10640 SHELL EFFECTS IN THE ATOMIC SLOWING ABILITY OF THE ELEMENTS FOR PROTONS. Pucherov, N. N.; Chesnokova, T. D. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 12, 2067-2068(Dec 1974). (In Russian).

As a result of analyzing the atomic slowing ability of substances for protons having energies up to 20 MeV it was found that the slowing ability depended on the structure of the electron shells of the atoms. The Bethe-Bloch formula was used to calculate the slowing ability by computer. The agreement of calculated values with experimental values is good for substances having a Z value less than 30. The experimental values are higher than the calculated values for heavy elements with Z > 30. (SJR)

10641 ESTABLISHING THE SPECTRUM OF A PROTON BEAM ACCORDING TO DOSE FIELD. Kalinichenko, A. I. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 12, 2065-2066(Dec 1974). (In Russian).

The configuration and magnitude of the dose field depend on the type of particle, beam parameters and characteristics of the target material. This study solves the problem of determining the proton energy according to dose field which arises on passage of a proton beam in a semi-infinite body. It is shown that the dose field in the material depends mainly on the ionization losses of the beam protons. Other forms of energy loss can be neglected. (SJR)

10642 THERMALIZATION OF POSITRONS AND POSITRONIUM. Kubica, P.; Stewart, A. T. (Queen's Univ., Kingston, Ontario). Phys. Rev. Lett.; 34: No. 14, 852-855(7 Apr 1975).

Positrons in metals and positronium in quartz have been observed to thermalize down to nearly liquid-helium temperatures before annihilation. The achievement of such low temperatures by both positrons and positronium in approximately 10^{-10} sec indicates that phonon scattering plays a major role in thermalization. These results have important implications for the ability to achieve high precision in Fermi-surface studies by the positron-annihilation technique. (auth)

10643 ON THE APPROXIMATE SOLUTION OF THE DELAY INTEGRAL EQUATION OF THE STATISTICAL THEORY OF RADIATION DAMAGE. Chamayou, J. M. F.; El Tom, M. E. A. (European Organization for Nuclear Research, Geneva (Switzerland)). Comput. Phys. Commun.; 9: No. 3, 131-140(Mar 1975).

In the statistical theory of radiation damage, the mean number of atoms displaced in the atomic cascade is given by a delay integral equation with specified initial conditions. Numerical procedures that use spline functions in conjunction with appropriate quadrature rules are presented for the construction of continuous approximations to the mean number of displaced atoms, represented by the delay integral. The methods presented are shown to be stable and to be of order (m + 1) for spline functions of degree m. Finally, the method for quadratic splines is used to compute the mean number of displaced atoms for atomic collisions with Firsov potentials, and with truncated Coulomb potentials. (auth)

Radiation Protection Standards

Refer also to abstracts 9142, 9198, and 10644.

10644 (RFB-SC-10) INSTALLATION AND SAFETY PROCEDURES FOR THE USE OF X RAYS IN MEDICAL THERAPY. (Department of National Health and Welfare, Ottawa, Ontario (Canada). Radiation Protection Div.). Dec 1974. 67p.

Procedures, installation arrangements, and safety facilities detailed in this code are for the instruction and guidance of all persons coming under the jurisdiction of the Federal Treasury Board Standards and Canada Labour (Safety) Code, using equipment that produces X-rays for medical therapy. Also included in this code are advisory sections for the specific guidance of (1) the radiotherapist, (2) the radiological physicist concerned with calibration procedures, equipment performance, and protection surveys, and (3) the equipment designer and manufacturer. (auth)

Radiation Source Calibration and Standardization

Refer also to abstracts 8885 and 10779.

PHYSICS (THEORETICAL)

General

Refer also to abstract 10643.

10645 (CONF-740713-, pp I.268) CONSTRUCTION OF INTERACTING AND ASYMPTOTIC FIELDS IN LAMBDAPHI$^4_4$ THEORY. Raczka, R. (Inst. of Physics, Warsaw). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The canonical formalism for nonlinear relativistic classical field theory is presented. It is shown that the solutions $\phi(x)$ of the nonlinear equation $(\Box + m^2)\phi(x) = \lambda\phi^3(x)$ as well as the asymptotic fields $\phi_{in}(x)$ and $\phi_{out}(x)$ are local relativistic fields with respect to Poisson brackets, with initial data as canonical variables. A convenient form for the generators of the Poincaré group is derived and the properties of the scattering operator are discussed. (Abstract only) (auth)

10646 BOUNDS TO QUANTUM MECHANICAL PROPERTIES: EXTENSIONS OF THE WEINHOLD–WANG PROCEDURE. Leopold, J. G.; Cohen, M.; Katriel, J. (Hebrew Univ., Jerusalem). J. Phys., B (London); 8: No. 4, 513-524(11 Mar 1975).

The Weinhold-Wang (Int. J. Quant. Chem.; 5: 215-20 (1971)) formula for bounds to overlap integrals was generalized so as to yield bounds to other quantum mechanical properties, including energies, expectation values and transition integrals. Calculations were performed for the hydrogen atom as well as for the hydrogen molecular ion, with excellent results. (auth)

10647 SYMMETRY IN QUANTUM SYSTEMS. Boya, L. J. (Zaragoza Univ., Spain). Int. J. Theor. Phys.; 11: No. 3, 187-192 (Nov 1974).

Homological algebra is used to derive some results in the theory of Lie groups. (auth)

10648 WIGNER DISTRIBUTION FUNCTION FOR AN OSCILLATOR. Davies, R. W. (Massachusetts Inst. of Tech., Lexington); Davies, K. T. R. Ann. Phys. (N. Y.); 89: No. 2, 261-273 (Feb 1975).

We present two new derivations of the Wigner distribution function for a simple harmonic oscillator Hamiltonian. Both methods are facilitated using a formula which expresses the Wigner function as a simple trace. The first method of derivation utilizes a modification of a theorem due to Messiah. An alternative procedure makes use of the coherent state representation of an oscillator. The Wigner distribution function gives a semiclassical joint probability for finding the system with given coordinates and momenta, and the joint probability is factorable for the special case of an oscillator. An important application of this result occurs in the theory of nuclear fission for calculating the probability distributions for the masses, kinetic energies, and vibrational energies of the fission fragments at infinite separation. (auth)

10649 SOME NONCLASSICAL FEATURES OF PHASE-SPACE REPRESENTATIONS OF QUANTUM MECHANICS. Srinivas, M.D. Wolf, E. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 11: No. 6, 1477-1485 (15 Mar 1975).

It is shown that phase-space distribution functions that characterize a single-particle quantum system obey a certain "generalized non-negativity condition," which reflects the fact that the density operator is a positive operator. A corresponding criterion is obtained for the associated characteristic functions and is found to resemble, to some extent, Bochner's theorem of classical probability theory. Necessary and sufficient conditions on a phase-space representation of quantum mechanics are also derived, which ensure that all the possible distribution functions in that representation are non-negative; but it is also shown that such distribution functions are not joint probabilities for position and momentum. In fact, our results readily provide a new proof of theorems of Wigner, and of Cohen and Margenau, which imply that quantum mechanics cannot be formulated as a stochastic theory in phase space. (auth)

10650 SUPERSINGULAR QUANTUM PERTURBATIONS. Detwiler, L.C.; Klauder, J.R. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. D 11: No. 6, 1436-1441 (15 Mar 1975).

A perturbation potential is called supersingular whenever generally every matrix element of the perturbation in the unperturbed eigenstates is infinite. It follows that supersingular perturbations do not have conventional perturbation expansions, say for energy eigenvalues. By invoking variational arguments, we determine the asymptotic behavior of the energy eigenvalues for asymptotically small values of the coupling constant of the supersingular perturbation. (auth)

10651 TENSOR EQUATIONS OF MOTION FOR THE EXCITATIONS OF ROTATIONALLY INVARIANT OR CHARGE-INDEPENDENT SYSTEMS. Rowe, D.J.; Ngo-Trong, C. (Department of Physics, University of Toronto, Toronto M5S 1A7 Ontario, Canada). Rev. Mod. Phys. 47: No. 2, 471-485 (Apr 1975).

A tensor equations-of-motion formalism for the excitation of a many-body system is presented, following the same general approach as the uncoupled formalism presented in a previous article. It is designed to take explicit account of the geometrical constraints imposed on excitation operators by the requirements that stationary states should have good angular momentum and, for a charge-independent nuclear Hamiltonian, good isospin. These developments are particularly relevant for application to molecular, atomic, and nuclear systems. By recognizing the geometrical constraints and exploiting the invariance properties of the excitation operators, the equations of motion become more readily applicable to nonscalar systems; i.e. to systems with nonzero angular momentum and/or isospin. (auth)

10652 INFINITE MATRICES, RITZ THEOREM, AND BOUND STATE PROBLEMS. Mitra, A. K. (Texas Tech Univ., Lubbock (USA). Dept. of Mathematics). Z. Naturforsch., A; 30: No. 2, 256-261(Feb 1975).

The straight forward application of the Ritz variational technique was shown to be a very convenient method for obtaining numerically the first few discrete eigenvalues of the Schroedinger operator with certain special types of potentials. This method solves essentially the (finite) matrix eigenvalue problem obtained by truncating the infinite matrix representing the Schroedinger operator with respect to the Coulomb wave functions. The Ritz theorem justifies the validity of this truncation procedure. (auth)

10653 REFLECTION AND REFRACTION OF LIGHT FROM A MOVING BLOCK OF GLASS. Lerche, I. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois). Phys. Rev. D 11: No. 4, 740-746 (15 Feb 1975).

For a block of glass moving with speed βc we present calculations which give the changes in the laws of reflection and refraction of light from the laws which hold when $\beta = 0$. In particular we show (i) that changes in the critical internal reflection condition, although formally of order β^2, are obtainable by measuring the refraction angle to $O(\beta)$; and (ii) the reflection coefficient depends not only on the polarization plane of the incident light but also on whether the plane of incidence does, or does not, include the direction of motion of the glass block. For instance, for light incident in a plane perpendicular to the direction of motion there is no Brewster angle for either plane of polarization, while for light incident in a plane containing the direction of motion at least one (and sometimes *both*) planes of polarization possess a Brewster angle. We have done these calculations in order to demonstrate that the shearing of one medium relative to another can have profound effects on the reflection and refraction of light. A major point here is that even when it might appear *a priori* that $O(\beta^2)$ phenomena are unobservable in the laboratory, the present calculations show that this is not always so. (auth)

Quantum Field Theories

Refer also to abstracts 10005, 10210, 10229, 10240, 10263–10264, 10290, 10292, 10352, 10380, 10384–10386, 10388, 10390, 10397–10398, 10420, 10426, 10570, and 10698.

10654 (CONF-740713-, pp I.243-I.250) STATUS OF CONSTRUCTIVE FIELD THEORY. Jaffe, A. (Harvard Univ., Cambridge, MA). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The progress of work during 1972 to 1974 to bring Constructive Field Theory (CFT) closer to physics is reviewed. The model with an interaction energy density $P(\phi(x))$ in d space-time dimensions is called $P(\phi)_d$. Models in $d < 4$ dimensions pose fewer problems in constructive field theory due to their super-renormalizable ultra-violet divergences. The case $d = 4$ is still the major challenge. Some of the results for $P(\phi)_2$ and Yukawa$_2$ are mentioned and $d = 3$ is also discussed. The mass spectrum $P(\phi)_2$ is considered. The author discusses one-sided bounds of field theory by mean field theory. The particle structure program was begun with the study of one particle states and two particle bound states. The continuation of this program should yield insight into many particle structure, bound states, resonances, and asymptotic completeness. An extensive bibliography is given. (UK)

10655 (CONF-740713-, pp I.266-I.267) WBK METHOD IN FIELD THEORY. Neveu, A. (Inst. for Advanced Study, Princeton, NJ). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

A short report is given on the general method to deal, in a quantum mechanical fashion, with systems with an infinite number of degrees of freedom (classical solutions of interacting field theories) which are relevant to particle physics. The idea is to extract as much information as possible from the classical system, to obtain results beyond perturbation theory. This is typically fruitful for the bound state problems. (UK)

10656 (CONF-740713-, pp I.267-I.268) TRANSLATION INVARIANT QUANTUM FIELD THEORY WITH DE-SITTER MOMENTUM SPACE OFF THE MASS SHELL. Donkov, A. D.; Kadyshevskii, V. G.; Mateev, J. D.; Mir-Kesimov, R. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

It is demonstrated that the off-mass-shell extension of the S-matrix in De-Sitter p-space is more adequate than the usual assumption that four dimensional space is flat, for high energies. It is shown that it is consistent with the requirements of Lorentz and translation invariance, unitarity, and spectrability. By Fourier transformation in De-Sitter p-space a new configuration quantized ξ-space is introduced. The direct natural generalization of Bogolubov's causality condition is formulated in terms of ξ-space. The problem of distribution products and ultraviolet divergencies loses its acuteness. (UK)

10657 (CONF-740713-, pp III.59-III.65) PROBLEMS IN GAUGE FIELD THEORIES. Weinberg, S. (Harvard Univ., Cambridge, MA). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Problems in gauge theories of strong, weak and electromagnetic interactions which are outstanding at the moment are discussed. Firstly the problem which consists of the two parts; why is the η mass not near the π mass, and why is $\eta \to 3\pi$ not suppressed by powers of m_π^2/m_η^2. The "standard" picture of weak, electromagnetic and strong interactions is outlined. Possible ways out of the η problem are discussed, the author favoring the solution that the standard model is right but the resulting low mass Goldstone boson ($m < \sqrt{3}\, m_\pi$) behaves like quarks and gluons, and does not appear in collisions of color-neutral particles. The observed η is the other unitary singlet Goldstone boson with a mass given (in the limit that $J^\mu_{5,c}$ conservation is much more strongly spontaneously broken than $\vec{J}_\mu$ conservation) given by the Gell-Mann Okubo result, roughly $\sqrt{\frac{1}{3}} m_K$. Secondly the problem of gauge symmetry breaking; if there are no unobserved leptons or weak interactions then the gauge theory of weak and electromagnetic interactions must be based on the group SU(2) × U(1). However this group is not simple. In consequence there are free dimensionless parameters which cannot be determined on a purely a priori basis. Possibilities to overcome this difficulty are considered. Finally the question of renormalization of gravitation with special reference to the suggested modification of general relativity is discussed. (UK)

10658 (CONF-740713-, pp III.65-III.76) REVIEW OF ASYMPTOTIC FREEDOM. Gross, D. (Princeton Univ., NJ). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

Arguments are put forward that suggest the necessity of asymptotically free theories of the strong interactions. The discovery that non-Abelian gauge theories are asymptotically free, and indeed that they alone possess this feature makes a compelling case for constructing Yang–Mills theories of the strong interactions. Models are discussed including Yang–Mills theories based on a semi-simple gauge group which are always free, a two loop calculation of β for non-Abelian gauge theories, incorporation of scalar mesons into a gauge theory, and low energy structure including dynamical symmetry breaking and confinement. Deep inelastic scattering is the most reliable way of probing the short distance structure of hadrons and could provide sensitive tests of asymptotic freedom. The problems of where does asymptopia set in, the sum rules, the determination of A^i_N, and the deviations from scaling are considered. (UK)

10659 (CONF-740713-, pp III.84-III.85) MAGNETIC MONOPOLES IN UNIFIED THEORIES. 't Hooft, G. (CERN, Geneva). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

In pure gauge theories with unbroken symmetry, there are spherically symmetric solutions which have arbitrary energy. In pure chirally symmetric scalar field theories, one might consider solutions with unconventional boundary conditions, but their energy is infinite except when they occur in rotating pairs. In gauge theories with Higgs mechanism there are spherically symmetric solutions with definite energy, but many of them will be unstable. A stable solution in all gauge models is reported here where the electromagnetic group U(1) is a subgroup of a semi-simple local gauge group like $SU(2)^{n_2} \times SU(3)^{n_3} \times \ldots$, etc. It will present itself to the observer as a finite mass magnetic monopole. Some theories might also allow for solutions with the topology of the dual string. It is not expected that analogous, stable, solutions exist in the current models for weak and electromagnetic interactions, but attempts have been made recently to construct mathematically more complicated vortex solutions. In an attempt to understand qualitatively the strong interactions that lead to quark confinement, one can construct models with a non-renormalizable "effective" Lagrangian, in which not the magnetic but the electric field lines are squeezed into quantized vortex lines. (UK)

10660 (CONF-740713-, pp III.85-III.88) LEPTON NUMBER AS THE FOURTH COLOR. Pati, J. C. (Univ. of Maryland, College Park). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The idea that only one variety of fermionic matter exists composed of baryonic quarks and leptons with no sharp distinction between them at the deepest level is discussed. The fact that only the baryons exhibit strong interactions at present energies and not the leptons is to be attributed to be a consequence of spontaneous symmetry-breaking; in this case universality of all interactions (weak, electromagnetic and strong) with respect to baryons and leptons must manifest itself at an appropriately high energy. The need for treating baryons and leptons in such a unified manner appear to be compelling by a desire to understand: (a) the emergence of baryon and lepton numbers, (b) baryon-lepton universality in the weak and electromagnetic interactions, and (c) quantization of electric charge. The idea of such unification may be realized in a variety of ways. The general consequences are considered. The scheme proposed, consisting of two 16-folds of chiral fermionic multiplets, is discussed. (UK)

10661 (CONF-740713-, pp III.89-III.116) PLENARY REPORT ON PROGRESS IN GAUGE THEORIES. Iliopoulos, J. (Ecole Normale Superieure, Paris). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The physical ideas which are behind the gauge theories and the recent progress made thereon are described. The discussion is under the following headings: Models; universality, the lepton spectrum, $1 + \gamma_5$ structure, the $|\Delta I| = \frac{1}{2}$ rule, CP violation, strong interaction symmetries, baryon number conservation, asymptotic freedom, and hierarchy of interactions. Experimental consequences. Field theory and renormalization; some further results on renormalization, Yang–Mills theories in the many-field limit, is quantum theory of gravity renormalizable, solutions of classical Yang–Mills theories, and gauge fields on a lattice. Spontaneous symmetry breaking; genesis of spontaneous symmetry breaking, abnormal nuclear states and vacuum excitation, and finite temperature effects. More symmetry. (150 references) (UK)

10662 (IC-75/24) RENORMALIZATION OF GAUGE THEORIES WITH BILINEAR GAUGE CONDITIONS. Gherman, O.; Tataru, L. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1975. 11p. Dep. NTIS (US Sales Only) $4.00.

By using a new technique developed by Becchi, Rouet, and Stora, a comprehensive discussion of the renormalization of gauge theories with and without spontaneous breakdown of gauge symmetry is given. The gauge condition is left rather arbitrary. The following conclusions are significant: the gauge condition may be rather arbitrary when it is linear in the fields, but it must have a particular form when it contains products of fields; the parameters that appear in the gauge condition are renormalized independently in a bilinear gauge condition; the renormalized S matrix is shown to be gauge independent and, therefore, unitary. (auth)

10663 (ITP-74-136E) THERMODYNAMICAL LIMIT IN PERTURBATION THEORY FOR THE SOLUTIONS OF THE BOGOLIUBOV KINETIC EQUATIONS. Vidybida, O. K. (AN

Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 8p. Dep. NTIS (US Sales Only) $4.00.

A thermodynamical limit in each term of the perturbation series in λ/ν for the solutions of the Bogoliubov kinetic equations is performed. (auth)

10664 (ORO-3992-218) EXACT SOLUTION TO GELL-MANN–LOW EQUATIONS IN A SIMPLE RELATIVISTIC MODEL. Deshpande, N. G. (Texas Univ., Austin (USA). Center for Particle Theory). 1973. 11p. Dep. NTIS $4.00.

The exactly soluble relativistic model field theory proposed by Zachariasen was studied. Renormalization of this model is carried out both in the conventional manner, and by choosing the point of renormalization at an arbitrary space-like momentum. The Gell-Mann–Low equations are then set up for the coupling constant, and the exact solution obtained. The asymptotic value of the coupling is seen to go to the bare constant. Some implications of the model are considered. (auth)

10665 (WIS-Ph-74/8) ZEROS AND INFINITIES OF CALLAN–SYMANZIK FUNCTION β IN A PERTURBATIVE APPROACH TO THE DASHEN–FRISHMAN MODEL. Roemer, H.; Yankielowicz, S.; Rubinstein, H. R. (Weizmann Inst. of Science, Rehovoth (Israel)). [nd]. 24p. INIS.

The Dashen-Frishman U(n)-symmetric generalized Thirring model is investigated in terms of perturbation theory. The possibility of an ϵ-expansion is established. The coefficient function $\beta(g)$ must have a singularity, which might also appear in more realistic models and possibly has important consequences for the I.R. and U.V. limits of field theories. (auth)

10666 WEYL'S GAUGE FIELD IN A NON-LOCAL FIELD. Ikeda, S. (Science Univ. of Tokyo). Int. J. Theor. Phys.; 11: No. 3, 205-212(Nov 1974).

A nonlocal field (i.e., the (χ, ψ)-field) is constructed by regarding the spinor (ψ) as the internal freedom attached to each point (χ). Since this field is likened to a unified field between the (χ)- and (ψ)-fields, the metric is given by $d\sigma\psi = g_\lambda\, d\chi^\lambda \psi$. Concerning this, some conformally equivalent relations are considered. Next, Weyl's gauge field is introduced into the concept of connection in order to consider the gauge invariance. Finally, some essential features underlying the nonlocal field are grasped by formulating some fundamental equations of the spin curvature tensors. (auth)

10667 COMMENTS ON THE ABSENCE OF SPONTANEOUS SYMMETRY BREAKING IN LOW DIMENSIONS. Ma, S. (Department of Physics and Institute for Pure and Applied Sciences, University of California, San Diego, California 92037; Rajaraman, R. Phys. Rev. D 11: No. 6, 1701-1704 (15 Mar 1975).

We present some comments intended to bring out simply and more explicitly the physics behind the rigorously proven results on the absence of continuous symmetry breaking in $(1 + 1)$ dimensions at $T = 0$ and $(2 + 1)$ dimensions for $T > 0$. It is also pointed out within a model that a massless boson is present, in a sense defined in the text, even though symmetry breaking disappears. (auth)

10668 INCLUSIVE ANNIHILATION IN YUKAWA THEORY. Coote, N. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 6, 1611-1634 (15 Mar 1975).

In the model of Yukawa field theory we consider the inclusive process $e^+ + e^- \to \gamma(p) \to \pi(k) +$ anything. We find, by summing up the logarithms, that certain transforms $H^{(n)}$ of the amplitude, which in the high-energy limit $u \equiv p^2 \to \infty$ may be identified with the moments $\int_0^1 d\omega\ \omega^{n+1}\ \bar{F}\ (\omega, p^2)$ of the structure functions $\bar{F}$ (ω, p^2), have simple leading behavior. At a fixed point of the renormalization group the $H^{(n)}$ would grow like a fractional power δ_n of p^2. δ_n is a property of the underlying theory (Yukawa) rather than the structure of the pion, treated as a bound state, and may be calculated in perturbation theory. (auth)

10669 INTERACTION OF A DENSE FERMION MEDIUM WITH A SCALAR-MESON FIELD. Lee, T.D.; Margulies, M. (Columbia University, New York, New York 10027). Phys. Rev. D 11: No. 6, 1591-1610 (15 Mar 1975).

The interaction between a dense fermion medium and a scalar-meson field is studied. It is shown that in the quasiclassical approximation, independently of the details of the theory, at low fermion density the lowest-energy state is normal (i.e., effective fermion mass $m_{\text{eff}} \simeq$ free mass), but at high density the state is abnormal (i.e., $m_{\text{eff}} \simeq 0$). The nature of the transition is analyzed at zero and low temperatures. Our main concern is to examine the problem of quantum fluctuation. Both the one- and two-loop diagrams are calculated. By developing a variational formalism involving only two-line irreducible diagrams, we derive a suitable high-density expansion for the energy. The quasiclassical solution emerges as the lowest-order term in this expansion. Therefore, when the expansion is valid, the overall description of the transition given by the quasiclassical solution remains correct with the inclusion of quantum corrections. (auth)

10670 EFFECTIVE-LAGRANGIAN FORMULATION OF GENERALIZED VECTOR DOMINANCE. II. Glück, M. (Institut für Physik der Johannes Gutenberg-Universität, Mainz, West Germany). Phys. Rev. D 11: No. 6, 1580-1585 (15 Mar 1975).

As in a preceding paper we generalize the Lagrangian of Lee and Zumino to include several mutually interacting vector mesons. The treatment is more general in the sense that *all* possible interactions between the vector mesons, compatible with the field-current proportionality relations, are now discussed. It is moreover demonstrated that also the fields corresponding to the *physical* vector mesons satisfy a field-current proportionality relation of exactly the same form. Comparison of the different schemes and their implications for the magnetic moments of the vector mesons are discussed. (auth)

10671 SUPERFIELDS AND FERMI-BOSE SYMMETRY. Salam, A. (International Centre for Theoretical Physics, Trieste, Italy); Strathdee, J. Phys. Rev. D 11: No. 6, 1521-1535 (15 Mar 1975). 1521-1535 (15 Mar 1975).

The realization of supergauge transformations on fields defined over an 8-dimensional space whose points are labeled by x_μ and the anticommuting Majorana spinor θ_α is described. The covariant derivative is defined and applied to the problem of decomposing superfields into irreducible (chiral) parts and to the problem of constructing "supersymmetric" Lagrangians. Further, it is shown how to build internal symmetries (both global and local) into these Lagrangians. An example is discussed in which the internal (global) symmetry is spontaneously violated, giving rise to a supermultiplet of Goldstone particles (including fermions). When a local symmetry is broken the Higgs mechanism (for bosons and fermions) is shown to be operative. A possible solution to the problem of defining a conserved fermion number is indicated. (auth)

10672 GLOBAL OPERATOR EXPANSIONS IN CONFORMALLY INVARIANT RELATIVISTIC QUANTUM FIELD THEORY. Schroer, B. (Institut für Theoretische Physik, Freie Universität, Berlin, Germany); Swieca, J.A.; Völkel, A.H. Phys. Rev. D 11: No. 6, 1509-1520 (15 Mar 1975).

We establish global conformal operator expansions in the Minkowski region in several models and discuss their formulation in the general theory. Whereas the vacuum expansions are termwise manifestly conformal-invariant, the expansions away from the vacuum do not share this property. (auth)

10673 FINITE-TEMPERATURE BEHAVIOR OF A RELATIVISTIC FIELD THEORY WITH DYNAMICAL SYMMETRY BREAKING. Dashen, R.F. (Institute for Advanced Study, Princeton, New Jersey 08540); Ma, S.; Rajaraman, R. Phys. Rev. D 11: No. 6, 1499-1508 (15 Mar 1975).

Recently, Gross and Neveu have studied a two-dimensional field theory of an N-component fermion in the large-N limit. This theory is asymptotically free and has dynamical spontaneous symmetry breaking. In this paper we study certain finite-temperature properties of this theory, especially those related to the survival of the "condensate," or symmetry breaking. Within the mean-field approximation, we find that the symmetry breaking disappears at a finite temperature T_0, which is of the same order of magnitude as the physical mass of a fermion. However, the mean-field approximation is not good for any finite N. At any nonzero temperature, however small, the system prefers to be in space-dependent field configurations such that the condensate vanishes. The critical temperature is thus zero. (auth)

10674 QUANTIZATION OF NONLINEAR WAVES. Goldstone, J.; Jackiw, R. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 11: No. 6, 1486-1498 (15 Mar 1975).

We suggest that certain nonlinear field theories possess a particle spectrum, richer than has been heretofore discussed. In addition to states associated with quantization of the free-field modes of oscillation —these are the conventional particles of the theory—there also appear heavy particles, which carry a new quantum number and are stable. An approximation scheme is developed in which the signal for these new particles is the existence of stable static solutions with finite energy to the classical equations of motion. We give a systematic expansion for the theory, with special emphasis on the translational motion. (auth)

10675 EXTERNAL-FIELD-INDUCED PHASE TRANSITION IN THE N-COMPONENT THIRRING MODEL. Harrington, B.J.; Park, S.Y.; Yildiz, A. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 11: No. 6, 1472-1476 (15 Mar 1975).

A two-dimensional field-theoretic model is considered in which chiral symmetry is dynamically broken in a nonperturbative manner. The response to an externally applied vector field is studied and a phase transition which restores the chiral symmetry is discovered. The critical field is explicitly calculated to all orders in the coupling constant and for any magnitude of the constant external field strength. (auth)

10676 BHABHA FIRST ORDER WAVE EQUATIONS. III. POINCARÉ GENERATORS. Krajcik, R.A.; Nieto, M.M. (Theoretical

Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. D 11: No. 6, 1459-1471 (15 Mar 1975).

We construct the Poincaré generators for arbitrary-spin Bhabha fields. After showing that for high-spin fields Hermiticity does not mean that the operators are self-adjoint, but rather satisfy Eqs. (2.16) and (2.17) below, we observe that these generators are Hermitian in this generalized sense. We explicitly demonstrate that the generators algebraically satisfy the associated Lie algebra for arbitrary half-integer-spin representations, but only as an operator algebra on the fields themselves for integer-spin representations. Specifically, of the six independent commutation relations $[K_i, K_j] = -i\epsilon_{ijk}J_k$ is not satisfied algebraically, and of the three dependent commutation relations $[K_i, H] = iP_i$ is not satisfied algebraically. By looking at the Sakata-Taketani decomposition of the Duffin-Kemmer-Petiau case, we find that it is only the built-in subsidiary components, not the particle components, which need an operator equation on the fields to satisfy the above two commutation relations. We generalize this result and show that the particle components for arbitrary-integer-spin fields satisfy the commutation relations algebraically. Finally, we comment on the interacting field case and problems associated with high-spin interacting field theories. (auth)

10677 BHABHA FIRST-ORDER WAVE EQUATIONS. II. MASS AND SPIN COMPOSITION, HAMILTONIANS, AND GENERAL SAKATA-TAKETANI REDUCTIONS. Krajcik, R.A.; Nieto, M.M. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. D 11: No. 6, 1442-1458 (15 Mar 1975).

Beginning with the Bhabha first-order wave equation of maximum spin 1 [the Duffin-Kemmer-Petiau (DKP) equation], where Sakata and Taketani (ST) separated out the "particle components" from the built in "subsidiary components," we derive for the first time the Hamiltonian equation for the "subsidiary components," and show that its solution is an identity in terms of the particle-components solution. We then derive a set of general inverse and ST operators for arbitrary-spin Bhabha fields. With these generalized operators we can discuss and understand the mass and spin composition of a general Bhabha so(5) field, it being a particular sum of $[2 \times (2S + 1)]$ components for each particular mass and spin (S) state, as well as built in "subsidiary components" for integer spin. We then can use these general inverse and ST operators to (a) derive the general Bhabha Hamiltonian for arbitrary spin, (b) decouple the "particle components" from the "subsidiary components" in the Hamiltonian equations for integer spin (where, as was the case for DKP, we find that the Hamiltonian "subsidiary components" solution is an identity in terms of the particle-components solution), and (c) decouple the $S + 1/2$ (S) different mass states for half-integer (integer) spin. We discuss the physical implications of this observation and other aspects of our results. (auth)

10678 QUANTUM FIELD THEORY IN SCHWARZSCHILD AND RINDLER SPACES. Boulware, D.G. (Physics Department, University of Washington, Seattle, Washington 98195). Phys. Rev. D 11: No. 6, 1404-1423 (15 Mar 1975).

The problem of defining a scalar quantum field in the space-times described by the Schwarzschild and Rindler metrics is discussed. The matrix elements of the field operators are found by calculating the Green's functions for the fields. The requirement of positive frequencies for *asymptotic* timelike separations combined with a careful analysis of the continuity conditions at the event horizons yields a unique prescription for the Green's function. This is turn defines the vacuum state. In the Schwarzschild space the vacuum is shown to be stable and the lowest-energy state. In the Rindler space the quantization procedure yields the same results as quantization in Minkowski coordinates. (auth)

10679 GENERALIZATION OF THE MOMENTUM-SPACE SUBTRACTION PROCEDURE FOR RENORMALIZED PERTURBATION THEORY. Gomes, M. (Sao Paulo Univ. (Brazil). Instituto de Fisica); Lowenstein, J. H.; Zimmermann, W. (New York Univ., N. Y. (USA). Dept. of Physics). Commun. Math. Phys.; 39: No. 2, 81-90(Dec 1974).

The momentum-space subtraction procedure for defining renormalized Feynman integrals is modified to allow for subtraction operators more general than the usual Taylor operators. The added generality permits one to assign subtraction degree less than four to some terms of the unperturbed Lagrangian. (auth)

10680 THE CONNECTION BETWEEN THE ENERGY-MOMENTUM TENSOR AND THE TENSOR FIELD IN PRESENCE OF A MASS GAP. Lopuszanski, J. T. (Wroclaw Univ. (Poland). Instytut Fyziki Teoretycznej). Commun. Math. Phys.; 38: No. 4, 317-330(Nov 1974).

The conditions under which a tensor field can be regarded as an energy-momentum tensor are discussed. The problem connected with dilatational and conformal symmetries are exhibited. (auth)

10681 ON LOCAL FUNCTIONS OF FIELDS. Landau, L. J. (Princeton Univ., N. J. (USA). Dept. of Physics). Commun. Math. Phys.; 39: No. 1, 49-62(Nov 1974).

Properties of local functions of fields are discussed. A condition, called the Borchers condition, is introduced which is weaker than duality but allows the construction of a maximal local extension of a system of local algebras. This extension will satisfy duality. The local structure of the generalized free field is studied, and it is shown that duality does not hold for the local algebras associated with certain generalized free fields, whereas the Borchers condition is satisfied for all generalized free fields. The appendix contains an elementary proof of duality for the free field. (auth)

10682 HIGH-ENERGY TEST OF QUANTUM ELECTRODYNAMICS. Jain, P.L.; Kazuno, M.; Girard, B. (High Energy Experimental Laboratory, Department of Physics, State University of New York at Buffalo, Buffalo, New York 14214). Phys. Rev. D 11: No. 5, 1341-1344 (1 Mar 1975).

Thirty-five directly produced electron pairs have been observed by following 150 m of 150-GeV muon track length in nuclear emulsion. These pairs have been compared with the pairs produced by 200-GeV protons and 15.8-GeV/c muons in terms of (i) their total energy distribution, (ii) the fractional transfer of the primary energy to the pairs, (iii) the energy partition between the two members, (iv) the angular divergence, (v) the invariant mass of the electron pairs, and (vi) the net transverse-momentum distribution of each pair. Present theories disagree with the experimental results. (auth)

10683 ASYMPTOTIC FREEDOM AND THE "ABSENCE" OF VECTOR-GLUON EXCHANGE IN WIDE-ANGLE HADRONIC COLLISIONS. Cahalan, R.F.; Geer, K.A. (Department of Physics, Syracuse University, Syracuse, New York 13210); Kogut, J.; Susskind, L. Phys. Rev. D 11: No. 5, 1199-1212 (1 Mar 1975).

The naive, pointlike parton model of Berman, Bjorken, and Kogut is generalized to scale-invariant and asymptotically free field theories. The asymptotically free field generalization is studied in detail. Although such theories contain vector fields, single vector-gluon exchange contributes insignificantly to wide-angle hadronic collisions. This follows from (1) the smallness of the invariant charge at small distances and (2) the breakdown of naive scaling in these theories. These effects should explain the apparent absence of vector exchange in inclusive and exclusive hadronic collisions at large momentum transfers observed at Fermilab and at the CERN ISR. (auth)

10684 LAMB SHIFT IN A STRONG COULOMB POTENTIAL. Mohr, P.J. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 34: No. 16, 1050-1052 (21 Apr 1975).

Results are given of a calculation of the self-energy radiative level shift of order α of the $2S_{1/2}$ and $2P_{1/2}$ states in a strong Coulomb potential. The shift is evaluated numerically to all orders in $Z\alpha$ for Z in the range 10–110. An estimate is obtained for the effect of terms of high order in $Z\alpha$ on the Lamb shift in hydrogen. With this estimate taken into account, the theoretical value is S=1057.864(14) MHz. (auth)

10685 RESTORATION OF DYNAMICALLY BROKEN SYMMETRIES AT FINITE TEMPERATURE. Harrington, B.J.; Yildiz, A. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 11: No. 4, 779-783 (15 Feb 1975).

A field-theoretic model is constructed which is asymptotically free for all temperatures and which possesses a phase transition in which masses are dynamically generated. The critical temperature above which the particle masses vanish is calculated in terms of the zero-temperature fermion mass. Our results may be of interest not only in theories of the early universe but also in the study of the formative stages of neutron stars. (auth)

10686 LORENTZ COVARIANCE AND MATTHEWS'S THEOREM FOR DERIVATIVE-COUPLED FIELD THEORIES. Bernard, C. (Jefferson Physical Laboratories, Harvard University, Cambridge, Massachusetts 02138); Duncan, A. Phys. Rev. D 11: No. 4, 848-859 (15 Feb 1975).

The canonical quantization of scalar-field Lagrangians involving at most first derivatives of the fields ("first-order" Lagrangian) or second derivatives ("second-order") is discussed. A direct, but necessarily perturbative, quantization procedure for a general first-order Lagrangian is used to show that such theories yield a Lorentz-invariant S matrix to low orders of perturbation theory provided a covariant regularization scheme (e.g., dimensional or Pauli-Villars—but *not* a high-momentum cutoff) is employed. Matthews's theorem is verified in this context—the naive Feynman rules are valid. Second-order Lagrangians, quadratic in second but arbitrary in first derivatives, are shown to satisfy Matthews's theorem to all orders of perturbation theory and to be equivalent to first-order theories with Pauli-Villars regularization, thereby yielding a proof of Matthews's theorem for an arbitrary Pauli-Villars-regulated first-order theory. It is shown that for spectral reasons second- (and presumably, higher-) order theories are unacceptable physically. Finally, the canonical quantization of a second-order gauge theory is performed explicitly; the results show that (a) the naive Faddeev-Popov prescription

remains valid in the presence of higher derivatives, and (b) the spectral pathology of second-order theories persists in gauge theories. (auth)

10687 STRINGLIKE SOLUTION OF THE HIGGS MODEL WITH MAGNETIC MONOPOLES. Jevicki, A.; Senjanović, P. (Department of Physics, The City College of the City University of New York, New York, New York 10031). Phys. Rev. D 11: No. 4, 860-865 (15 Feb 1975).

We derive a static solution of the equations of motion following from a Higgs-type Lagrangian containing, in addition, static magnetic monopoles representing quarks. For this purpose, we use Zwanziger's approach to magnetic monopoles, and thus we are dealing with a local field theory for charged particles. We show that the solution has the form of a string of finite length for large coupling. We exhibit the dependence of the energy of the system (E) on interquark distance ($2a$), $E(2a) = -(g^2/8\pi a)\exp(-e|\Phi_0|2a) + C|\Phi_0|^2 a$, which is the form found by Nambu in his discussion of this type of model as a scheme which offers a mechanism for quark confinement. We therefore confirm that Nambu's results can be reached in a field-theoretic formulation. (auth)

10688 VALUES OF FUNDAMENTAL CONSTANTS. Parisi, G. (Department of Physics, Columbia University, New York, New York 10027). Phys. Rev. D 11: No. 4, 909-910 (15 Feb 1975).

We study how renormalized coupling constants depend on the cutoff in a renormalized field theory. Assuming that the cutoff is connected with quantum gravity effects, relations are found between the fine-structure constant α, the total cross section e^+e^- into hadrons, and the weak-interaction angle θ_w. (auth)

10689 HIGHER-ORDER EFFECTS IN A UNIFIED MODEL OF STRONG, WEAK AND ELECTROMAGNETIC INTERACTIONS. Ross, D.A. (Department of Physics, Imperial College, London SW7, England). Phys. Rev. D 11: No. 4, 911-923 (15 Feb 1975).

In this paper the techniques of renormalization of spontaneously broken non-Abelian gauge theory are applied to higher-order calculations in the unified model of strong, weak, and electromagnetic interactions due to Pati and Salam. A brief resumé of these techniques and of the model is presented. In the rest of the paper higher-order strong- and weak-interaction processes are calculated to show that the processes which are suppressed in the tree-diagram approximation remain small in higher order and that the differences between hadronic and leptonic masses and weak interactions, which are absent in lowest order, arise from higher-order strong interactions. (auth)

10690 NEUTRINO THEORY OF LIGHT FROM THE VIEWPOINT OF THE BETHE-SALPETER EQUATION. Sarkar, H.; Bhattacharya, B.; Baudyopadhyay, P. (Indian Statistical Institute, Calcutta-35, India). Phys. Rev. D 11: No. 4, 935-938 (15 Feb 1975).

The possibility that the photon may be a composite state of a neutrino-antineutrino pair has been examined here in the framework of the Bethe-Salpeter equation. The formalism takes into account the photon-neutrino weak interaction. It is shown that in this special case, when the exchanged particle mass $\mu = 0$ as well as the total mass of the interacting spinors $m = 0$, we must introduce a cutoff factor Λ corresponding to the introduction of a fundamental length l_0 ($\Lambda \sim 1/l_0$). The solution of the Bethe-Salpeter equation is found to be associated with a discrete spectrum and the energy expression is found to be of the form $E^2 = 2\Lambda^2[2-(1/n^2)(g^2/4\pi)^2]$, where $n = 1,2,3,...$, and g denotes the photoneutrino weak coupling strength. (auth)

10691 EXISTENCE OF HEAVY PARTICLES IN GAUGE FIELD THEORIES. Tyupkin, Yu.S.; Fateev, V.A.; Shvarts, A.S. (Moscow Engineering Physics Institute). JETP Lett. 21: No. 1, 42-43 (5 Jan 1975).

We formulate the conditions for the existence of heavy particles in gauge theories with arbitrary singly connected compact group G. The case of the active representation of the SU(3) group is investigated in detail. (auth)

10692 CONCERNING THE EXISTENCE OF MONOPOLES IN GAUGE FIELD THEORIES. Monastyrskiĭ, M.I.; Perelomov, A.M. (Institute of Theoretical and Experimental Physics). JETP Lett. 21: No. 1, 43-44 (5 Jan 1975).

A simple topological criterion is presented for the existence of monopoles in gauge-invariant theories with arbitrary compact symmetry group G. (auth)

10693 A FINITE ELEMENT PROGRAM PACKAGE FOR AXISYMMETRIC VECTOR FIELD PROBLEMS. Konrad, A.; Silvester, P. (McGill Univ., Montreal, Quebec (Canada). Dept. of Electrical Engineering). Comput. Phys. Commun.; 9: No. 3, 193-204(Mar 1975).

The following types of problems can be solved with the program: electromagnetic field problems requiring solution to the one-component vector Poisson or Helmholtz equation in cylindrical coordinates with no azimuthal variation (e.g. transformer problems, unsaturated magnetic lens problems, linear accelerator cavities); electric field problems requiring azimuthally periodic solutions to the scalar Laplace, Poisson or Helmholtz equation (i.e., solutions to the generalized Bessel equation of order m); a host of mathematically related problems which fall in the above two categories (e.g. heat and fluid flow problems). The generalized Bessel equation of order m, derivable from the vector Helmholtz equation for m = 1 under the assumption of one vector component in the azimuthal direction and no azimuthal variation, or derivable from the scalar Helmholtz equation under the assumption of azimuthal periodicity, is solved by the high order polynomial triangular finite-element method using an approximation technique which avoids singularities of the 1/r type at the axis of symmetry. (auth)

10694 LOCAL SATURATION OF FIELD COMMUTATORS. Skirko, I. F.; Voronov, B. L. (AN SSSR, Moscow. Fizicheskij Inst.). Phys. Lett., B; 55: No. 5, 477-480(17 Mar 1975).

Any problem of local saturation of field commutator matrix elements for fields with asymptotic in-limit is reduced to solving the appropriately truncated set of equations for the r-functions. A new version of local saturation is proposed. (auth)

10695 EXACT AND PERTURBATIVE SOLUTIONS FOR THE VACUUM POLARIZATION IN A SOLUBLE MODEL IN SCALAR FIELD THEORY. Rothe, K. D. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 88: No. 3, 501-524(7 Apr 1975).

The relation between exact and perturbative solutions in a renormalizable field theory is studied for the case of all outer rainbow diagrams contributing to the self-energy of a scalar field in $\lambda\Phi^2\psi^2$ theory with one $\Phi\psi^2$ insertion. The graphs are summed using Bethe-Salpeter techniques. The solution exhibits a canonical light-cone singularity modified by a strongly oscillating factor. The expansion of the exact solution to order $O(g^2\lambda^2)$ in the coupling constant is found to agree with the corresponding result obtained in renormalized perturbation theory for a particular choice of normalization conditions. It is argued that a particular discontinuity $\rho(q^2)$ of this class of graphs may be relevant to e^+e^- annihilation. The quantity $\rho(q^2)$ is found to rise with q^2 like $(q^2)^{\gamma(\lambda)+1}$, where $\gamma(\lambda) \geq 1$ for $\lambda \geq 0$. (auth)

10696 BETHE-SALPETER METHOD FOR FIELDS WITH ANOMALOUS DIMENSIONS. Ciafaloni, M. (Scuola Normale Superiore, Pisa (Italy)); Ferrara, S. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 88: No. 3, 365-380(7 Apr 1975).

Scale invariant solutions of (bootstrap) field equations for several interactions are studied by replacing the Bethe-Salpeter kernel with an effective potential which is required to be local and scale-invariant. It is shown that this method (which linearizes the bootstrap) gives correct anomalies of fundamental fields and correct wave functions of composite fields to leading order in the ϵ expansion. Successive orders can be studied by iteration and perturbation theory. Some consequences for the calculation of form factors are also pointed out. (auth)

Gravitation and General Relativity

Refer also to abstracts 9763, 9904, 10273, and 10678.

10697 (AD-780195) USE OF SYMBOLIC MANIPULATION TECHNIQUES TO EXAMINE GRAVITATIONAL AND UNIFIED FIELD THEORIES. Final Technical Report, 30 June 1973–15 June 1974. Yilmaz, H.; Pavelle, R. (Perception Technology Corp., Winchester, Mass. (USA)). 15 Jun 1974. 89p. NTIS $4.00.

Topics discussed include verification of the field equations, equations of motion and conservation laws, skew-symmetric phi sub mu nu and unified field theory, new capabilities of Macsyma, and the tensor package. (GRA)

10698 (CONF-740713-, pp I.264-I.266) QUANTUM GRAVITY. Deser, S. (Brandeis Univ., Waltham, MA). 1974.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In proceedings of the XVII international conference on high energy physics.

The report is divided into three distinct sections; the first deals with tree diagrams, and is devoted to a derivation of general relativity as the unique generator (at low frequency) of the tree expansion, given only the observed properties of gravitational forces and the principles of S-matrix theory. The second section deals with the ultraviolet behavior of general relativity considered as a quantum field theory. In the last section some prospects are discussed for improving the catastrophic situation which arises there. (UK)

10699 HARMONIC MAPPINGS OF RIEMANNIAN MANIFOLDS AND STATIONARY VACUUM SPACE-TIMES WITH WHOLE CYLINDER SYMMETRY. Eriş, A.; Nutku, Y. (Department of Physics, Middle East Technical University, Ankara, Turkey). J. Math. Phys. (N.Y.) 16: No. 7, 1431-1434 (July 1975).

We consider stationary, cylindrically-symmetric gravitational fields in the framework of harmonic mappings of Riemannian manifolds. In this approach the emphasis is on a correspondence between the solution of the Einstein field equations and the geodesics in an appropriate Riemannian configuration space. Using Hamilton–Jacobi techniques, we obtain the geodesics and construct the resulting space–time geometries. We find that the light cone structure of the configuration space delineates the distinct exterior fields of Lewis and van Stockum which together form the most general solution with whole cylinder symmetry. (auth)

10700 SELF-GRAVITATING FLUIDS WITH CYLINDRICAL SYMMETRY. Letelier, P.S. (Department of Physics, Boston University, Boston, Massachusetts 02215). J. Math. Phys. (N.Y.) 16: No. 7, 1488-1490 (July 1975).

The general solution of the Einstein field equation is obtained under the assumptions that (1) the source of the gravitational field is a perfect fluid with pressure p, equal to energy density ρ, (2) the space–time is cylindrically symmetric, and (3) the metric is given by three functions of two variables. The coordinate transformation to comoving coordinates is discussed. The energy and the Hawking–Penrose inequalities are studied. The singularities of a class of solutions is studied using the concept of velocity-dominated singularity. A relation between Einstein–Rosen waves and a class of solutions is shown. (auth)

10701 MACH'S PRINCIPLE AND THE REST MASS OF THE GRAVITON. Woodward, J.F.; Crowley, R.J. (California State University, Fullerton, California 92634); Yourgrau, W. Phys. Rev. D 11: No. 6, 1371-1374 (15 Mar 1975).

The question of the graviton rest mass is briefly discussed and then it is shown that the Sciama-Dicke formulation of Mach's principle admits, in the linear approximation, the calculation of the graviton rest mass. One finds that the value of the graviton rest mass depends on the cosmological model adopted, the mean matter density in the universe, the speed of light, and the constant of gravitation. The value obtained for an infinite, stationary universe is $7.6 \times 10^{-}$ 10^{-67} g. The value for evolutionary cosmological models is found to depend critically on the mass and "radius" of the universe, both null and non-null values occurring only for certain values of these parameters. Problems that arise as a consequence of the linear approximation are pointed out. (auth)

10702 SOLUTIONS OF THE NONSYMMETRIC UNIFIED FIELD THEORY. Moffat, J.W.; Boal, D.H. (Department of Physics, University of Toronto, Toronto, Ontario, Canada). Phys. Rev. D 11: No. 6, 1375-1382 (15 Mar 1975).

The field equations in a formulation of Einstein's nonsymmetric unified field theory are solved exactly for the case of a static, spherically symmetric point singularity. The equations also yield the correct equations of motion in the lowest nontrivial order of approximation using the methods of Einstein, Infeld, and Hoffmann. When a universal constant k vanishes, the theory reduces to the Einstein-Maxwell equations and the solution found here becomes the Reissner-Nordström solution. A coordinate singularity occurs in the metric when $r = m + (m^2 - Q^2/2)^{1/2}$, as in the Reissner-Nordström solution. It is shown that this singularity is due to the choice of coordinates by performing a Kruskal-Szerkeres-type transformation. Further the exact solutions which are generated by a Hermitian tensor, rather than a real nonsymmetric tensor, are given. Finally, the gauge invariance and possible renormalization of the theory are discussed. (auth)

10703 RADIATION FROM ELECTRONS IN CURVED SPACES. Villarroel, D. (Departamento de Física, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Santiago, Chile). Phys. Rev. D 11: No. 6, 1383-1386 (15 Mar 1975).

It is shown that the energy-momentum tensor of the electromagnetic field, for an electron in a curved space, may be split into two dynamically independent parts. One of them, the radiation tensor, has the following remarkable properties: (i) its covariant divergence vanishes off the electron world-line; (ii) it has no flux through light cones with apex on the world-line; (iii) its diagonal terms are positive definite under arbitrary coordinate transformations. This tensor is essentially determined by the above-mentioned properties. The radiation tensor describes at least part of the radiated energy. (auth)

10704 PLANE WAVE SOLUTIONS OF THE FIELD EQUATIONS OF GENERAL RELATIVITY. Ali, N. (M. L. K. Coll., Gonda, India). Indian J. Pure Appl. Math.; 4: No. 7-8, 664-669 (1973).

A generalisation of the plane wave solutions has been attempted by assuming the space–time metric with all its components as functions of a single variable Z(z, t). This approach has the advantage that the general solutions so obtained reduce to different types of plane wave solutions under restricted conditions. (auth)

10705 GRAVITATIONAL FIELD EQUATIONS AND THE POSSIBILITY OF TIME VARIATION OF ALL MASSES. Malin, S. (Department of Physics and Astronomy, Colgate University, Hamilton, New York 13346). Phys. Rev. D 11: No. 4, 707-710 (15 Feb 1975).

Recent developments in spontaneously broken gauge theories as well as in group analysis of cosmological models indicate that rest masses may change on the cosmological scale. Such an effect contradicts Einstein's equations of general relativity. The possibility of replacing Einstein's equations by the equations $R_{\mu\nu} = -4\pi\kappa T_{\mu\nu}$ is explored. Cosmological models are calculated and time variation of all masses is derived for all isotropic, spatially homogeneous models. The result is $\dot{m}/m = -3H$, where H is Hubble's constant. It is shown that the equations $R_{\mu\nu} = -4\pi\kappa T_{\mu\nu}$ are not precluded by presently available observational and experimental data. (auth)

10706 EFFECT OF THE GYRO'S QUADRUPOLE MOMENT ON THE RELATIVITY GYROSCOPE EXPERIMENT. Barker, B.M.; O'Connell, R.F. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Phys. Rev. D 11: No. 4, 711-715 (15 Feb 1975).

We show that the quadrupole moment of the gyro affects the drift rate of the presently planned Stanford gyroscope experiment by (0.0254 "/yr) sin 2α, where α is the angle between the gyro's spin axis and the orbit plane. Thus, if the gyro's spin axis is off by more than one degree from being either in the orbit plane or perpendicular to the orbit plane the drift rate will exceed 0.001 "/yr, which is the expected accuracy of the experiment, and, hence, this predictable drift rate will have to be taken into account to preserve the expected accuracy of the experiment. We also calculate the precession of the orbit of the gyro due to the gyro's quadrupole moment and find it two orders of magnitude smaller than the precession of the orbit due to the gyro's spin. (auth)

10707 ELECTROMAGNETIC RADIATION DUE TO SPACETIME OSCILLATIONS. Chitre, D.M.; Price, R.H.; Sandberg, V.D. (Department of Physics, University of Utah, Salt Lake City, Utah 84112). Phys. Rev. D 11: No. 4, 747-759 (15 Feb 1975).

Wave equations are derived in the Newman-Penrose formalism for mixed electromagnetic and gravitational perturbations on both a flat spacetime background and a slightly charged ($Q^2 \ll GM^2$) Reissner-Nordström background. The physical meaning of these equations is discussed and analytical results are derived for nonrelativistic sources and for ultrarelativistic particle motions. The relationship between even-parity (TM) electromagnetic radiation multipoles in the long-wavelength approximation and static multipoles is shown to be the same as for classical radiation, suggesting a simple picture for electromagnetic radiation induced by gravitational perturbations. (auth)

10708 ELECTROMAGNETIC RADIATION GENERATED BY GRAVITATIONAL PERTURBATIONS OF A CHARGED ROTATING BLACK HOLE. Chitre, D.M. (Department of Physics, University of Utah, Salt Lake City, Utah 84112). Phys. Rev. D 11: No. 4, 760-762 (15 Feb 1975).

Gravitational perturbations on a mildly charged Kerr black hole are analyzed. These perturbations distort the static electromagnetic field to give rise to electromagnetic radiation. A wave equation for the electromagnetic radiation is derived in the Newman-Penrose formalism. (auth)

10709 INSTABILITY OF INTERMEDIATE SINGULARITIES IN GENERAL RELATIVITY. King, A.R. (Department of Mathematics, University College London, Gower St. London WC1, England). Phys. Rev. D 11: No. 4, 763-767 (15 Feb 1975).

It has been shown that "intermediate" singularities, where all Riemann tensor invariants are finite, occur in certain cosmological models. Associated with the singularities are Cauchy horizons, across which the matter flows into a stationary region of space-time. We investigate scalar-wave propagation in these spaces. Our results suggest that the intermediate singularities become localized curvature singularities while the Cauchy horizons are a stable feature of the models. (auth)

10710 QUANTIZATION OF A FRIEDMANN UNIVERSE FILLED WITH A SCALAR FIELD. Blyth, W.F.; Isham, C.J. (Department of Mathematics, King's College, London, England). Phys. Rev. D 11: No. 4, 768-778 (15 Feb 1975).

The problem of quantizing a Robertson-Walker metric with a scalar field as source is discussed within the framework of a true canonical theory. A discussion is given of the role played by different choices of time. (auth)

10711 CONSERVED VECTORS IN SCALAR-TENSOR GRAVITATIONAL THEORIES. Hart, H.B. (Department of Physics, Western Illinois University, Macomb, Illinois 61455). Phys. Rev. D 11: No. 4, 960-962 (15 Feb 1975).

Two recently derived expressions for the Brans-Dicke scalar-tensor analog of Komar's conserved vector density are compared, and it is shown that they give different results for the total energy of the scalar-tensor Schwarzschild universe. (auth)

10712 DERIVATION OF THE STRING EQUATION OF MOTION IN GENERAL RELATIVITY. Gürses, M.; Gürsey, F. (Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. D 11: No. 4, 967-969 (15 Feb 1975).

It is shown that the equation of motion for a Nambu string in

curved space can be derived from the gravitational field equation following the method of Einstein, Infeld, and Hoffman. (auth)

10713 THE GENERAL RELATIVISTIC FIELDS OF A CHARGED ROTATING SOURCE. Finkelstein, R.J. (Department of Physics, University of California, Los Angeles, California 90024). J. Math. Phys. (N.Y.) 16: No. 6, 1271-1277 (June 1975).

The gravitational and electromagnetic fields of a charged, rotating source are obtained by an elementary algebraic method. (auth)

10714 UNPHYSICAL SOLUTIONS OF YANG'S GRAVITATIONAL-FIELD EQUATIONS. Pavelle, R. (Innovation Industries, Woburn, Massachusetts 01801). Phys. Rev. Lett. 34: No. 17, 1114-1114 (28 Apr 1975).

A static, spherically symmetric solution of Yang's vacuum gravitational field equations is given which predicts incorrect values for experimental observations. It is argued that Yang's field equations must be supplemented by further restrictions on the class of allowable space-times. (auth)

10715 POLARIZATION OF GRAVITATIONAL GEODESIC SYNCHROTRON RADIATION. Breuer, R. A. (Univ. Observatory, Oxford); Tiomno, J.; Vishveshwara, C. V. Nuovo Cim., 25B: No. 2, 851-870(11 Feb 1975).

Gravitational radiation as emitted by a test particle moving in a relativistic geodesic circular orbit in the Schwarzschild geometry. For this purpose one first gives a compact version of the perturbation technique (using tensor spherical harmonics) for tensor radiation perturbing the Schwarzschild geometry. The polarization properties are analyzed with the help of gravitational Stokes parameters. The radiation is almost totally linearly polarized within the main beam, but the various polarization quantities depend much more strongly on the latitude angle of observation than they do for the analogous electromagnetic radiation at the same frequencies. (auth)

REACTOR TECHNOLOGY AND REGULATION

10716 (AD-779357) MIDDLE EAST NUCLEAR DESALTING: STATUS AND OUTLOOK. Student Essay. Neiler, J. H. (Army War Coll., Carlisle Barracks, Pa. (USA)). 15 Jan 1974. 34p. NTIS $4.75.

The history of a proposed US alternative for the Middle East was analyzed to determine the criteria by which it was measured and found unacceptable, even though apparently strongly endorsed by the Senate. The criteria are then applied to an evaluation of the prospects for future use of the basic technological concept. It was found that the specific alternative proposed was not considered useful by the Senate or administration. Further, the concept of using an expensive economic development project in the hope of solving a political problem was rejected. Escalating costs of nuclear power equipment, and time to availability of large scale water distillation technology also made the feasibility of the project questionable. Current methods of evaluating economic return preclude acceptance of nuclear power desalting alternatives for at least a decade. (GRA)

10717 (INIS-mf-1642) ANNUAL REPORT, 1973. (Stockholm Univ. (Sweden). Institutionen foer Oorganisk och Fysikalisk Kemi). 1974. 92p. (In Dutch). INIS.

The DeBeNeLux project at present occupies the larger part of the RCN research effort. This includes the Dutch share in the sodium cooled fast breeder reactor project (SNR) of Germany and the Benelux countries. Determination of the reactivity effects of long-living and stable fission products is done in STEK, a fast-thermal coupled reactor. The measuring program terminated in the end of 1973. Experiments on sodium boiling using electrically heated dummy fuel pins are conducted with a 12-rod bundle to study the heat transfer. Fuel pin failure in the pool side facility of the HFR is carried out to study the simulated loss-of-cooling. Investigations with aerosols include the effect of condensing sodium vapor on the aerosol lifetime. Low-cycle fatigue on the creep and tensile properties of the SNR-300 structural steel were carried out. Work on gas cooled reactors in Holland is done in participation in the OECD Dragon project for the development of the HTR, the OECD-NEA working group on Gas Cooled Fast Reactors and the (industrial) Gas Cooled Fast Breeder Association. An internal working group of RCN on waste management, which suggested storage of radioactive solid wastes in one of the many salt domes under Dutch jurisdiction, goes on studying the possibilities under the name of STORA project. The HFR reactor is used for: production of isotopes, activation analysis, research in solid state and nuclear physics in cooperation with FOM, universities, governmental and industrial institutes. The development of the KEMA suspension test reactor (KSTR) is reported. RCN work related to light water reactors and their fuel cycle nowadays consists largely of services to the Dutch organizations involved; government departments, power stations and manufacturing industry. Assistance to the licensing authorities in connection with the Borssele nuclear power plant was one of the principal activities of RCN. Other activities are numerical computations in support of industrial projects and development of the requisite programmes. Since the beginning of 1973 a new CDC-6600 computer installation has been available at Petten. Assistance was given in solving fabrication problems to the gas centrifuge manufacturing plant of UCN in Almelo and will be given for further centrifuge development to the second tripartite corporation, CENTEC GmbH. The major part of this work is carried out in a special laboratory in Amsterdam. A development program which RCN has undertaken jointly with other share holders in Interfuel B. V., comprises constructional improvements, chiefly on the fuel rod spacer grids, and the application of "vibrasol" fuel, made by vibration compaction of spherical particles prepared by the sol-gel method. A review is given of reactor operations of the HFR, LFR and STEK reactors, health physics experiments, services, non-nuclear research, public information, input of nuclear information to INIS, training, international relations, personnel, finance and investments. (INIS)

10718 (NP-20385) ELECTRICITY FROM NUCLEAR POWER: A MAP OF NUCLEAR POWER PLANTS IN THE U. S. (Atomic Industrial Forum, Inc., New York (USA)). 1975. 14p. AIF, New York 10016.

Locations and reactor names are given for operable reactors and also those under construction, on order, and planned reactors for which letters of intent or options have been filed. A chronological listing of power plants is also provided. (DG)

10719 EVOLUTION OF THE NATIONAL PARTICIPATION IN THE CONSTRUCTION OF SPANISH NUCLEAR POWER PLANTS. Gaitan Cuellar, I. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 18: No. 90, 217-221(1974). (In Spanish).

The successive evaluations on the degree of national participation in the construction of nuclear power plants in Spain are briefly reviewed and discussed. The concept of national participation and national contribution is defined. The evaluation of the national participation in power plants in operation and under construction is reported. The corresponding contributions in equipment are evaluated separately. (tr-auth)

10720 NUCLEAR STANDARDS AND STANDARD NUCLEAR PLANTS: MORE THAN MONEY IS AT STAKE. Olds, F. C. Power Eng.; 79: No. 3, 42-49(Mar 1975).

The movement toward standard nuclear power plants is reviewed and some of the expected benefits of standardization are discussed. (JWR)

10721 KERNENERGIE. Adressen, Namen, Bezugsquellen in der Bundesrepublik Deutschland. (Nuclear Energy. Directory, Who's Who, Buyers' Guide of the Federal Republic of Germany). Mueller, W. D.; Hossner, R. (eds.). Duesseldorf, F. R. Germany; Handelsblatt Verl. (1974). 166p. (In German).

The most important addresses in the field of nuclear energy in the Federal Republic of Germany, i.e., governmental authorities, research establishments, the power industry, nuclear energy authorities abroad, names, i.e., "Who is who in German nuclear energy", as well as an index of suppliers in the nuclear field in the FRG with: (1) the various nuclear technological products and services available and (2) an index of firms are given. (GE)

10722 AN OWN NUCLEAR TECHNOLOGY. Milia, F. A. Bol. Cent. Nav.; 91: No. 697, 393-398(Oct 1973). (In Spanish).

Evaluations are made of technology and its incidence in the economic policies of Argentina and the questions of national interest to be resolved are formulated. The first is a consideration of the reasons for the installation of a second power reactor when the first has not yet been put into operation. The second question refers to the location of the second reactor in the Province of Cordoba. The neglect of technical innovation in many political directives with the corollary of improvisation when administrative decisions are adopted to problems requiring or involving the application of science is discussed. This nuclear approach to the energy problem will generate dependence on foreign nations in the short term. The origin of the dependence is the fuel in the case of enriched U or of heavy water in the case of natural U. To this can be added the deficiency of support technology and industry. Inaction in the nuclear realm is not predicted, on the contrary a very decided progress in this area is foreseen. It is indicated that to be limited to the installation of power reactors without developing capacity in the technological field and specific and support engineering will be a vast inversion offering ephemeral prestige but lasting dependence. (INIS)

10723 N-PLANT MONITORING IMPROVES RELIABILITY. Selig, B. J.; Runde, H. A.; Kosky, R. P. (Combustion Engineering Inc., Windsor, CT). Electr. World.; 181: No. 10, 44-48(15 May 1974).

New monitoring techniques and requirements have been developed in recent years to improve the safety and reliability of nuclear power plants. These are in addition to the functions normally monitored in the control room, and they include, but are not limited to, these areas: In-service inspection, internals-vibration monitoring, loose-parts monitoring, and measuring primary-coolant boron concentration in pressurized water reactors. (Elect. Electron. Abstr.)

10724 PRESENT STATE AND OUTLOOK OF THE HUNGARIAN NUCLEAR POWER PLANT PROGRAM. Szivos, K.; Sandor, D. Fiz. Szemle; 24: No. 7, 211-214(Jul 1974). (In Hungarian).

According to present plans, 60 to 75% of the power plants to be built in Hungary by 2000 will be nuclear. The first nuclear plant is under construction at Paks; its initial 880-MW(e) unit, scheduled to be ready by 1980, will consist of two 440-MW WWER-type pressurized-water reactors to be obtained from the Soviet Union. This type presents the advantage of a very high specific heat load of the fuel elements and a small core resulting from the excellent moderating properties of the water. In view of this high power density, at the 500 MW level the investment expenses per unit capacity approach those of conventional plant. The design also ensures a high burnup level. The nominal rating will be increased to 1000 MW(e) in future plants, beyond which no further economy can be expected. Work is in progress in the Soviet Union on graphite-moderated, tubular and high-capacity boiling-water reactors. The future belongs to the sodium-cooled fast breeder reactors but because of the many technical difficulties they are not expected to be in operation before the 1990's. (TTT)

10725 NUCLEAR SALES AND OUTLOOK. A Compilation of Articles Carried in 1974 Nucleonics Week. Nucleonics Week Special Report. New York; McGraw-Hill, Inc. (1974). 33p.

News items, selected from 1974 issues of Nucleonics Week, concerning sales of nuclear power plants are presented. (JWR)

10726 POWER AND RESEARCH REACTORS IN MEMBER STATES. 1974 Edition. Vienna; IAEA (1974). 78p.

This is the seventh issue of the comprehensive list of land-based nuclear power and research reactors in the Member States of the Agency, which is published once a year. As before, this list includes data on all reactors in operation, under construction and planned; wherever available, the cumulative electric power generated up to December 1973 is given for operating plants. To illustrate the considerable projected growth in the installed capacities of power reactors, in the number of research reactors in various countries and the cumulative reactor years of experience, numerical tables and graphs are presented. Power reactors that have been closed down are identified and the dismantled research reactors have been taken off the list. To facilitate scanning the document, a reactor name index for both power and research reactors is provided, which also indicates the volumes of the Directory of Nuclear Reactors in which the full descriptions of these reactors can be found. (INIS)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 11030, 11033, 11044, 11051, 11054, 11068, and 11069.

10727 (AED-CONF-75-023-007) EXPERIMENTAL AND THEORETICAL BURNUP INVESTIGATIONS ON MODEL ARRANGEMENTS WITH SOLID BURNABLE POISONS. Ahlf, J.; Anders, D.; Greim, L.; Knoth, J.; Kolb, M.; Mittelstaedt, B.; Mueller, A.; Schwenke, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1975. 10p. (In German). INIS.

From KTG-special meeting "long-term behaviour"; Stuttgart, F. R. Germany (25 Feb 1975).

In light water reactors with high burnup excess reactivity, solid burnable neutron poisons are used for reactivity compensation. To get differences between the actual and the nominal value of the multiplication factor smaller than Δk approximately 0.01, one has to predict the effectiveness of the solid burnable poison for any burnup state with an accuracy of about 5%. To test suited calculational measuring and experimental techniques the Geesthacht research center conducts burnup studies in mockups. Two completed burnup experiments are described. (GE)

10728 (ERDA-30(4/75)) STATUS OF CENTRAL STATION NUCLEAR POWER REACTORS: SIGNIFICANT MILESTONES. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). 1 Apr 1975. 13p. Dep. NTIS $4.00.

Information on U. S. power reactors is listed concerning the reactor type, electrical capacity (MW(e)), manufacturer, public announcement date, contract award date, construction permit and operating license application and issuance dates, initial criticality, first electrical production, fuel power, and commercial operation date. (DCC)

10729 (LA-5852) SOLA: A NUMERICAL SOLUTION ALGORITHM FOR TRANSIENT FLUID FLOWS. Hirt, C. W.; Nichols, B. D.; Romero, N. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 50p. Dep. NTIS $5.45.

A finite difference technique is presented for solving the Navier-Stokes equations for an incompressible fluid. The technique, based on the Marker-and-Cell method, is simplified to facilitate its use by persons with little or no experience in numerical fluid dynamics. Section I of the report describes the basic algorithm, SOLA, for confined flows; Sec. II describes modifications necessary for free or curved rigid surface boundaries. Each includes a flow chart and a FORTRAN listing. Sample problems show how to incorporate simple modifications into the basic code to adapt it to a variety of problems. (auth)

10730 (ORNL-RUS-3) CITIZENS' VIEWS ABOUT THE PROPOSED HARTSVILLE NUCLEAR POWER PLANT: A PRELIMINARY REPORT OF POTENTIAL SOCIAL IMPACTS. Schuller, C. R.; Fowler, J. R.; Mattingly, T. J. Jr.; Sundstrom, E.; Lounsbury, J.; Passino, E. M.; Dowell, D. A.; Hutton, B. J. (Oak Ridge National Lab., Tenn. (USA)). May 1975. Contract W-7405-eng-26. 82p. Dep. NTIS $7.25.

Preliminary results of a survey of public attitudes toward a proposed nuclear power plant facility at Hartsville, Tennessee are summarized. The purpose of the study was to aid in developing better methods for understanding the social consequences of energy facility development. The report is based on data obtained in interviews with 350 randomly selected respondents administered in Trousdale County, Tennessee during February 1975. (auth)

10731 (XN-CC-21(Rev. 2)) XPOSE: THE EXXON NUCLEAR REVISED LEOPARD. Skogen, F. B. (Exxon Nuclear Co., Richland, Wash. (USA)). Apr 1975. 114p. Exxon Nuclear Co., Richland, WA.

A description is given of the XPOSE code, an Exxon Nuclear modified version of LEOPARD which is based on a modified MUFT-SUFOCATE model. The XPOSE code determines fast and thermal spectra using only geometry and temperature data as input. A burnup option is available in which the variation of neutron spectra with fuel depletion is accounted for. The burnup calculation is nonspatial. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 10727–10728, 10731, 11033, 11035–11037, 11041, 11047, 11055, 11061–11063, 11065, 11068–11069, 11115–11117, and 11125.

10732 (AED-CONF-75-023-008) CALCULATION OF THE REACTIVITY PATTERN OF THE KWO REACTOR DURING THE FIRST CYCLE. Lutz, D. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). 1975. 7p. (In German). INIS.

From KTG-special meeting "long-term behaviour"; Stuttgart, F. R. Germany (25 Feb 1975).

With abstract.

The accuracy demands of reactor calculations rose in the last years due to safety and economic reasons. At the same time changes in the fuel element concept like the insertion of burnable poisons made improvements in the calculational methods necessary. The problem of calculating the longtime behavior of a power reactor using basic data is analyzed. The disadvantage of using expensive calculational methods is described. The Obrigheim reactor is analyzed because of its simple core geometry in the first cycle. (GE)

10733 (BC-TOP-5-A) PRESTRESSED CONCRETE NUCLEAR REACTOR CONTAINMENT STRUCTURES. Revision 3. Reuter, H. R.; Chang-Lo, P. L. C.; Pfeifer, B. W.; Shah, G. H.; Whitcraft, J. S. (Bechtel Power Corp., San Francisco, Calif. (USA)). Feb 1975. vp. Bechtel Power Corp., San Francisco, CA.

A discussion of the techniques and procedures used for the design of prestressed concrete nuclear reactor containment structures is presented. A physical description of Bechtel designed containment structures is presented. The design bases and load combinations are given for anticipated conditions of service. Reference design documents which include industry codes, specifications, AEC Regulatory Guides, Bechtel Topical Reports and additional criteria as appropriate to containment design are listed. Stepwise procedures typically followed by Bechtel for design of containments is discussed and design examples are presented. A description of currently used analytical methods and the practical application of these methods for containment design is also presented. The principal containment construction materials are identified and codes of practice pertaining to construction procedures are listed. Preoperational structural testing procedures and post-operational surveillance programs are furnished along with results of tests on completed containment structures. (auth)

10734 (CENPD-187) CEPAN: METHOD OF ANALYZING CREEP COLLAPSE OF OVAL CLADDING. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Jun 1975. 67p. Combustion Engs., Inc.

A method is described for investigating the creep deformation of unsupported fuel cladding with (or without) initial ovality in its cross section subjected to in-reactor conditions of net external pressure, fast neutron flux and elevated temperature. In the absence of continuous support from fuel pellets or internal rod pressurization, creep deformation can accumulate and produce collapse of fuel rod cladding. The analytical basis of the CE creep collapse model is described. A consistent set of equations is derived which governs the radial, tangential and axial creep deformation of the cladding. Also discussed is the CE effective stress-effective strain rate creep law that is applicable to Zircaloy-4 cladding in a state of biaxial stress. This analysis is

incorporated into a finite difference code (CEPAN). The predictive capabilities of the model include the analysis of cladding subjected to either constant or variable loading. (12 references) (auth)

10735 (EUR-5227f) ARDENNES NUCLEAR POWER PLANT, ANNUAL REPORT, 1973. (Societe d'Energie Nucleaire Franco-Belge des Ardennes, Brussels (Belgium)). Dec 1974. 45p. (In French). Dep. NTIS (US Sales Only) $5.25.

The SENA nuclear power plant continued to operate at the authorized power level of 905 MW(t) during the first half year and 950 MW(t) during the second half year. Operational data are presented. (DG)

10736 (MRR-141) CONCEPTUAL MALFUNCTION ANALYSIS, ILLUSTRATED BY THE EXAMPLE OF A FAILURE OF THE MAIN COOLANT PUMP IN A PWR. Buettner, W. E. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Oct 1974. 33p. (In German). INIS.

The report presents the development of a cause-consequence diagram, which can be used for an one-line analysis of system irregularities. This disturbance leading to the malfunction of a main coolant pump of a pressurized water reactor is used as an example. (auth)

10737 (NP-20420) 8-GRID 17 X 17 FUEL ASSEMBLY VIBRATION IN A D-LOOP TEST. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). May 1975. 19p. Westinghouse Electric Corp., Pittsburgh, PA.

For the Phase III, D-loop test of the 17 x 17 guide tube, an 8-grid 17 x 17 fuel assembly was supplied as an ancillary test component. In this test phase, anomalous vibrations of the fuel rod indicated fuel assembly vibrations at discrete frequencies and constant amplitude over sharply defined flow ranges. Such vibration had not been observed in previous tests. An investigation was undertaken to evaluate if the fuel assembly design required a modification to preclude this vibration. This report summarizes the nature of the anomalous vibration, the probable cause postulated, and the tests conducted to verify that hypothesis. It was concluded that the vibrations observed in the initial Phase III, D-loop test were a result of the specific test configuration and resulting flow conditions and are non-prototypical. No anomalous vibrations could be induced or were observed in subsequent tests of 8 grid assembly configurations which simulated actual in-reactor conditions. No modification of the fuel assembly design was found to be necessary. (auth)

10738 (WCAP-8531) POWER RAMP DEMONSTRATIONS IN WESTINGHOUSE PWRs. Sipush, P. J. (ed.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Apr 1975. 60p. Westinghouse Electric Corp., Pittsburgh, PA 15230.

The Westinghouse program of fuel transient response studies is described. Included are a general description of the Power Ramp Demonstration (PRD) program, a compilation of past Westinghouse test programs and data obtained, the PRD prospectus through early 1976, the safety analysis to be performed for each proposed PRD, and a delineation of the PRD procedure. A typical detailed PRD procedure written for the reactor operators is also included. (DG)

10739 (XN-209) DENSIFICATION EFFECTS ON EXXON NUCLEAR PRESSURIZED WATER REACTOR FUEL. (Exxon Nuclear Co., Richland, Wash. (USA)). Mar 1974. vp. Exxon Nuclear Co., Inc., Richland, WA.

Individual reports are included on the following subjects: power spike model for PWR fuel; cladding collapse calculational procedure; GASPRX calculation procedure for internal gas pressure due to fission gas release; pellet-to-cladding gap closure from pellet cracking; and GAPEXX program for predicting pellet-to-cladding heat transfer coefficients. (JWR)

10740 (XN-CC-28(Rev. 3)) XTG: A TWO-GROUP THREE-DIMENSIONAL REACTOR SIMULATOR UTILIZING COARSE MESH SPACING (PWR VERSION). Stout, R. B. (Exxon Nuclear Co., Richland, Wash. (USA)). Jan 1975. 75p. Exxon Nuclear Co., Richland, WA.

XTG is a three dimensional simulated two group diffusion theory program which is designed to operate with large mesh sizes. The large mesh spacing allows full core calculations without prohibitive computer cost. XTG uses diffusion theory to solve for the fast group flux in each node. The thermal flux is calculated from the fast flux assuming the only source of thermal neutrons is slowing from the fast group and no thermal leakage occurs within each node. A correction to this assumption is made using averaging factors and the flux values of the six nearest neighbors. Inner iterations are performed on the fast group flux, but the thermal flux is updated only after each outer iteration. After a specified number of iterations, the cross sections are updated to reflect power dependence on xenon, Doppler broadening, thermalhydraulic feedback, and iteration on critical boron concentration. The method of solution results in rapid convergence. (auth)

10741 AUTOMATION SOLVES WINTER COOLING TOWER PROBLEMS. Baird, C. A.; Behen, J. E. Jr. Power Eng.; No. 5, 36-39(May 1975).

The automated operation of the cooling tower at Three Mile Island Nuclear Station is described. The tower was designed to limit the cool down flow (about twice the normal flow) to a discharge temperature of 87°F on the hottest day. A special problem involved operation of the tower during sub-zero winter days, requiring much of the manual operator's time, the building being apart from the main plant complex. The automation design and instrumentation are described. Automation of mechanical draft cooling towers costs less than $50,000 and permits the lowest possible safe discharge temperature during ambient freezing conditions. (MCW)

10742 WATER CHEMISTRY AND CORROSION LIMITATION AT THE BBR STEAM GENERATOR SYSTEM. Ernstberger, R. (Babcock-Brown Boveri Reaktor G.m.b.H., Mannheim (F. R. Germany)); Pocock, F. J. (Babcock and Wilcox Co., Alliance, Ohio (USA). Research and Development Div.). VGB Kraftwerkstech.; 54: No. 10, 691-696(Oct 1974). (In German).

The primary and secondary side of the system, the water chemistry of both sides as well as the cleaning of the steam generator and the using of inconel 600 as steam generator material, stress effect, impurities and material structural state are described. (GE)

10743 INFLUENCE OF COOLANT TEMPERATURE FLUCTUATIONS ON THE SPECTRAL POWER DENSITY OF IONIZATION CHAMBER NOISE IN PRESSURIZED WATER REACTORS OF WWER TYPE. Meyer, K. Kernenergie; 18: No. 3, 66-69(1975). (In German).

In the present paper the influence of fluctuations of coolant temperature on spectral power density of ionization chamber noise are studied using the point model. For this purpose, in addition to the fluctuating entrance temperature of the coolant a phenomenologically introduced fluctuation of the coolant temperature in the cooling channels is considered. However, it is shown that the influence of the former is dominating. Possible consequences with respect to interpretations of experimental results are discussed. (auth)

10744 DESIGNING A NUCLEAR POWER STATION WITH 1000 MW WATER-MODERATED WATER-COOLED REACTOR UNITS. Berkovich, V. M.; Kaloshin, Yu.P.; Tatarnikov, V. P.; Shenderovich, A. S. Therm. Eng. (USSR) (Engl. Transl.); 21: No. 4, 22-27(Apr 1974).

Translated from Teploenergetika; 21: No. 4, 18-22(Apr 1974).

The development of 1000 MW WWER type reactors is described. (JWR)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 9018, 10728, 11042, and 11069.

10745 (AED-CONF-75-023-005) PHYSICAL LAYOUT OF THE HTR-1,160. Huebner, A.; Brandes, S. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany)). 1975. 19p. (In German). INIS.

From KTG-special meeting "long-term behaviour"; Stuttgart, F. R. Germany (25 Feb 1975).

With abstract in English and German.

The physics design is presented for the reactor core of the helium cooled, graphite moderated high temperature reactor HTR-1,160. A discussion is given of the design criteria, the calculational methods, the burnup cycle, the power distribution and the reactivity control. (auth)

10746 (AED-CONF-75-023-006) FUELING FLEXIBILITY OF THE THTR-300 AFTER LONG TIME SHUTDOWN. Gutsch, U.; Patscher, W. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany)). 1975. 16p. (In German). INIS.

From KTG-special meeting "long-term behaviour"; Stuttgart, F. R. Germany (25 Feb 1975).

With abstract in English and German. Available from ZAED.

The design of the THTR-pebble bed reactor is based on the thorium-uranium fuel cycle with continuous refueling. Under steady operating conditions the core is in an equilibrium state with stationary isotopic densities. During an extended shutdown period, however, the protactinium, which is bred from thorium,

decays into fissile U-233. This decay produces an excess reactivity, which after restarting reduces relatively slowly during the normal refueling. This can be used to obtain a greater flexibility in the refueling strategy. It will be shown, that the reactor after a shutdown period can be operated for several days or weeks with reduced or without any fueling. Such modifications of the fueling mode have no serious consequences on the axial core composition or the reactivity behavior after the restart of fueling. (auth)

10747 (AED-CONF-75-023-012) THE LONG-TERM-BEHAVIOR OF THE AVR-CORE. Wagemann, R.; Wahl, D. J.; Krueger, K. (Arbeitsgemeinschaft Versuchs-Reaktor G.m.b.H., Juelich (F. R. Germany)). 1975. 32p. (In German). INIS.

From KTG-special meeting "long-term-behavior"; Stuttgart, F. R. Germany (25 Feb 1975).

With abstract.

A numerical treatment of the long-term physics behavior of the AVR-reactor, which has been in operation since 1967, is presented. At present, the AVR is operated at a coolant gas temperature of 950°C, while originally designed for 850°C. The pebble-bed-core consists of 7 different spherical fuel element types. The mode of operation requires extensive reactor-following calculations because of the rather poor shut-down system, the statistical fueling method, and the lack of in core instrumentation. (auth)

10748 (AED-CONF-75-003-014) INVESTIGATION INTO THE POSSIBILITIES OF AFTER-HEAT REMOVAL WITHOUT FORCED CIRCULATION IN THE HTR. Lukaszewicz, J.; Bonka, H. (Gesellschaft fuer Hochtemperaturreaktor-Technik m.b.H., Bensberg (F. R. Germany)). 1975. 21p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

At full cooling gas pressure of 40 bar, the removal of after-heat from the pebble bed by natural convection presents no problem. The operational temperatures are merely immaterially exceeded in the fuel elements. Even at small pressures, a maximum temperature of only about 2,300°C is reached. The temperatures in the pebble bed are thus within the controllable regions so that the fuel elements are not destroyed. According to the present state of knowledge, it seems to still be necessary to have a forced circulation cooling to remove the after-heat. However, it is possible with a special construction that even in the case of the hypothetical assumption of the failure of all blowers and after-heat removal circuits over an indefinite period of time, the situation in the reactor core is under control. (GE)

10749 (AED-CONF-75-003-015) PRESTRESSED CONCRETE CONTAINMENTS OF HIGH-TEMPERATURE REACTORS. Mitterbacher, P.; Weyden, V. D. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany)). 1975. 6p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

The work describes the control system for prestressed concrete vessels which are built for the reactors THTR 300 and HTR 1160. It is shown that all non-determinable failures by this system can be considered in the design of the prestressed concrete vessels so as to guarantee the required mechanical strength. (GE)

10750 (CEA-CONF-2849) DIRECT CYCLES ADAPTED FOR NUCLEAR POWER PLANTS. Pierre; Chaboseau. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). 1974. 51p. (In French). INIS.

From a conference cycle concerning new energy production systems and associated thermodynamical cycles; Ermenonville, France (30 Sep 1974).

In a direct cycle nuclear plant a high-temperature reactor is combined with a turbo-compressor placed on the same circuit through which flows a compressible single-phase fluid, in this case helium gas. The main properties of the corresponding thermodynamic cycle are recalled. The improvements contemplated relate to the increase in the number of compressions and expansions. In view of the pressure losses and the minimum cold temperature of the cycle the economic optimum for a helium turbine nuclear power station is obtained with a two-compression cycle, though for dual-purpose stations the one-compression formula is still preferable. CO_2 and N_2O_4 cycles have been considered. The technology of the circuit, running conditions, waste discharge and heat production are mentioned. Original features of the helium turbine in its adaptation to nuclear power stations are described taking into account their general lay-out. (FR)

10751 (GA-A-13057) ULTIMATE STRENGTH OF PRESTRESSED CONCRETE REACTOR VESSEL END SLABS. Cheung, K. C.; Gotschall, H. L.; Liu, T. C. (General Atomic Co., San Diego, Calif. (USA)). 1 May 1975. 44p. General Atomic Co., San Diego, CA.

It is generally recognized that the failure of a PCRV end slab is greatly influenced by the resistance of the concrete under complex states of stress. The shear-flexure interaction procedure presented represents a rational approach in the assessment of the ultimate strength of the end slab. The basis and development of the empirical shear-flexure interaction expression are presented. The development is based on a wide range of test data resulting from model studies in which the effects of major parameters on the ultimate strength of the full scale structures were investigated. It is felt that this approach provides a convenient and rational method for accounting for important parameters including geometry, material properties, and level of prestress. The application of the shear-flexure interaction procedure is demonstrated on a model PCRV which was tested to failure in shear. (auth)

10752 (GA-A-13168) STRONTIUM TRANSPORT DATA FOR HTGR SYSTEMS. Myers, B. F.; Bell, W. E. (General Atomic Co., San Diego, Calif. (USA)). 6 Dec 1974. Contract AT(04-3)-167. vp. (GA-LTR-16). Dep. NTIS $5.45.

Strontium transport data applicable to HTGR systems are assembled and discussed; reference values have been derived from the available data and are presented in the form of equations and parameters suitable for use as input for reactor calculations. The reference data presented cover the following processes: (1) the diffusion of strontium in fuel kernels and in pyrocarbon, (2) sorption of strontium in fuel rod matrix material, (3) sorption of strontium in graphite, and (4) diffusion of strontium in graphite. (auth)

10753 (GERHTR-105) HHT/HTRB PROGRESS REPORT, 1973. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). 1973. 6p. (In German). Dep. NTIS (US Sales Only) $4.00.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

The most significant developments made in the high temperature helium turbine (HHT) and high temperature reactor fuel element (HTRB) projects are briefly summarized. A list of published topical reports is appended. (JSR)

10754 (GERHTR-107) 1973 PROGRESS REPORT OF THE INSTITUTE OF REACTOR MATERIALS. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). 1973. 30p. (In German). Dep. NTIS (US Sales Only) $4.50.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

Results obtained in the development, characterization, and irradiation testing of materials for power reactors are reported. Included are data concerned with the development of spherical and block-shaped fuel elements and the fuel element components such as the fuel core, coating, graphitic matrix, and graphite for the high temperature reactors THTR, HHT, HTR 1160, and NPW. A list of publications and reports is appended. (JSR)

10755 (JUL-1169) INVESTIGATIONS OF THE SHORT-TIME DYNAMICS OF OTTO-PEBBLE-BED REACTORS. Scharf, H. J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Feb 1975. 169p. (In German). Dep. NTIS (US Sales Only) $11.50.

For investigations of the short-time dynamics of pebble-bed HTR's with an OTTO loading scheme the computer code DYNOTTO was written. On the nuclear side the one-dimensional, two group diffusion equation is solved in the axial direction by means of a finite difference algorithm with an automatically controlled time-step variation. This is completed by a detailed thermohydraulic model. As an essential innovation the program can also treat the accident "ingress of water" that is of crucial importance for HTR's with a secondary steam cycle. The basic equation and relations underlying this program are described briefly. Results which were obtained by applying the program to the analysis of the short-time behavior of the so called PR 500 are described. The accentuation of this investigation was laid on the analysis of the disturbance response. Therefore a subsequent interference of the control system was renounced for most of the analyzed cases. The results demonstrate the excellent inherent safety properties of the investigated reactor, whose short-time behavior is determined essentially by the upper third of the core with its high power-density. Very high power peaks occur during the specified reactivity accidents, but the obtained temperatures represent no immediate danger for the core in any of the analyzed cases. As the most important result one can conclude from the calculations that a possible ingress of water into the primary circuit can be coped with even under very pessimistic assumptions. (auth)

10756 (JUL-1172) ANALYTICAL TREATMENT OF TWO-DIMENSIONAL HEAT CONDUCTIVITY IN A RECTANGULAR CROSS SECTION UNDER GIVEN BOUNDARY CONDITIONS.

Achenbach, E.; Iniotakis, N. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorbauelemente). Mar 1975. 14p. (In German). Dep. NTIS (US Sales Only) $4.00.

The analytical solution is given for the two-dimensional heat conduction in a rectangular cross section. The boundary conditions are as follows: three sides of the rectangle are kept at a constant temperature whereas heat is transferred from the fourth side to a fluid. This problem arises when the local heat transfer is measured by means of a flush mounted plug thermally insulated from the surroundings. This method was applied to determine the local heat transfer coefficient of smooth and rough surfaced heat exchangers for gas-cooled nuclear reactors. (auth)

10757 (LA-5902-MS) PRESTRESSED CONCRETE REACTOR VESSELS: REVIEW OF DESIGN AND FAILURE CRITERIA. Endebrook, E. G. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1975. Contract W-7405-eng-36. 9p. Dep. NTIS $4.00.

The design and failure criteria of prestressed concrete reactor vessels (PCRVs) are reviewed along with the analysis methods. The mechanical properties of concrete under multiaxial stresses are not adequately quantified or described to permit an accurate analysis of a PCRV. Structural analysis of PCRVs almost universally utilizes a finite element which encounters difficulties in numerical solution of the governing equations and in treatment of fractured elements. (auth)

10758 FUTURE-ORIENTED COUPLING AND INTERCONNECTED SYSTEMS FOR COAL REFINING. Peters, W.; Schilling, H. D. (Bergbau-Forschung G.m.b.H., Essen (F. R. Germany)). Chem.-Ztg., Chem. App.; 98: No. 9, 431-438(Sep 1974). (In German).

The coupling of coal gasification and high-temperature reactors is described as well as the transport of nuclear reactor heat by long distance interconnection of gasification and recombination processes. Subject to futher consideration is the combination of coal gasification of fluidized bed combusiton with gas/steam turbine processes as well as the possibility of primary pyrolysis of power plant coal. A short description of coal liquefaction processes is presented. (auth)

10759 METHOD OF QUANTITATIVELY DETERMINING TRACE IMPURITIES IN INERT GAS SYSTEMS. Bailey, D. M.; Abel, W. T.; Salgado, P. G. (to Secretary of the Interior). US Patent 3,332,745. 25 Jul 1967. Filed date 20 Dec 1963. 6p.

A method for the determination of impurities in an inert gas system such as a helium-cooled reactor is presented. (JWR)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 11069, 11100, and 11107.

10760 (AECL-5038) SPATIAL REACTOR MODELS FOR NUCLEAR POWER PLANT SIMULATIONS. Green, R. E.; Argue, D. S.; Lawrence, C. B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1975. 21p. (CONF-7410124-1). Dep. NTIS (US Sales Only) $4.25. AECL $0.50.

From IAEA specialists meeting on spatial control problems; Studsvik, Sweden (28 Oct 1974).

Recent work at CRNL aimed at the development of few-zone reactor models for use in real-time, hybrid-computer simulations of CANDU nuclear power plants is described. Two-, four- and seven-zone models have been developed, based on the nodal approach of Avery, with coupling coefficients between zones determined from a two-dimensional, finite-difference calculation, embodied in the digital-computer code BEIWERT. The models have been implemented on three EAI TR-48 analog computers coupled to a PDP-8 digital computer. As expected, all three models have small-signal responses in excellent agreement with the theory. The two-zone model was compared with split-core kinetics experiments performed in the ZED-2 test reactor and good agreement was obtained. The seven-zone model was used to simulate the BLW-cooled G-1 reactor. The fundamental transfer function of the model agrees well with measurements made at G-1, while the first azimuthal response is considerably less than the measured response. The hybrid model also predicts spatial flux tilts and regional overpowers for a G-1 refuelling operation that are smaller than those obtained with the STABIL code, a digital-computer version of the same model. The discrepancies are attributed to the fact that due to hardware limitations, only the self-coupling terms in the analog model can be varied during a transient, and that in the model, the zones have roughly equal power and one control rod each, whereas in G-1 the control rods are clustered towards the center of the core. A new hybrid computer system is being acquired which should permit real-time simulation of reactors with up to 38 zones. A brief description of this model is given. (auth)

10761 (BARC/I-266) SOME SMALL SCALE EXPERIMENTS ON STEEL BALL FILLED END SHIELD MODEL. Kakodkar, A.; Ghosh, A. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 41p. INIS.

A steel-ball-filled endshield is being developed for the Narora Atomic Power Station. The work to investigate the mechanical and thermal behavior of this system has been divided in small scale experiments and large scale experiments. The experiments and results of the filling test, pressure drop in both corroded and uncorroded conditions, and heat transfer characteristics on tube sheet and lattice tube are reported here. (auth)

10762 (EBO-310-32) OPERATING INSTRUCTIONS OF THE KS-150 REACTOR. I. Physics Part. Rana, S. B.; Hezoucky, F.; Kmosena, J.; Valovic, J.; Paulicka, I.; Krstenik, A.; Rohar, S. (Atomova Elektraren, Jaslovske Bohunice (Czechoslovakia)). 1972. 192p. (In Slovak). INIS.

The principal parameters of the KS-150 reactor, vital for safe and economical operation of the A-1 nuclear power plant are summed up, such as the design data on the reactor and its core, the physical parameters of the respective core regions, the spatial distribution and the absolute value of neutron flux, the pressure and the temperature reactivity coefficients, the analysis of reactor poisoning at various outputs, changes in reactivity with the fuel burnup, the reactor period in positive stepwise changes in reactivity, the weight of various absorption rod configurations, refuelling modes and the thermal characteristics of the reactor. Particular attention is devoted to the analysis of emergencies resulting from a reduced coolant flow through the core. Also surveyed are the parameters of the A-1 nuclear power plant basic equipment. (INIS)

10763 RADIOLOGICAL PROTECTION AND SGHW REACTORS. Palmer, G. H. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). Radiol. Prot. Bull.; No. 11, 4-8(Apr 1975).

The radiological protection problems in the SGHW reactor are assessed. Consideration is given to the hazards associated with normal operation at full power, operation with failed fuel in the core, different maintenance operations, the build-up of tritium in the heavy water moderator, and the storage of fuel pins in a cold water pond. The main radiological problems occur during maintenance, and are predominatly the control of radiation dose from external radiation to maintenance staff. The operation of the prototype reactor at Winfrith has helped to identify and suggest solutions to the problems encountered, and such problems can be minimized in a commercial design. (UK)

10764 CANDU NUCLEAR REACTOR AND INDUSTRY. Robertson, R. F. S. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). CIM (Can. Min. Metall.) Bull.; 68: No. 755, 105-106 (Mar 1975).

The CANDU reactor has now proven itself to be a safe and economic source of electric power. Natural gas and oil are becoming expensive and scarce. Electricity, which today provides for only 20% of our power needs, will have an ever-increasing share in the future. The energy sources of this electrical power must be hydraulic, coal or uranium. All will play an important role. AECL is assessing where nuclear energy can supplement fossil fuels as a source not only of electricity, but also of steam or heat for Canadian industry. The status of these studies is described. (auth)

10765 NUCLEAR POWER: IMPACT AND OPPORTUNITIES. Leaist, G. T. (Atomic Energy of Canada Ltd., Ottawa). Chem. Can.; 27: No. 3, 16-18(Mar 1975).

Forecasts by the Canadian Nuclear Association, the National Energy Board and AECL indicate that by 1990, Canada will have an installed nuclear generating capacity of between 30,000 MW(e) and 40,000 MW(e), and by the year 2000 between 100,000 MW(e) and 135,000 MW(e). The majority of these nuclear power plants are expected to be CANDU reactors of basic design. For this nuclear construction program, the outlay for equipment and services, not including financial cost, will amount to about $70 billion (1974). Uranium accounts for only 3% of CANDU costs. An increase in the price of uranium would make fuel cycles based on thorium or plutonium economically attractive. Plutonium recycle offers attractive possibilities for application with a CANDU-BLW reactor design. A single CANDU-PHW reactor would produce sufficient plutonium to meet the annual fuelling requirements of 4.5 plutonium burning BLW's. Although there are additional costs associated with the use of thorium, it yields much more energy for a given amount of fuel. (CA)

Power Reactors, Breeding

Refer also to abstracts 9024, 9544, 10728, 10801, 11038–11040, 11043, 11045, 11070, and 11121.

10766 (AED-CONF-75-003-005) EXPERIMENTAL AND THEORETICAL INVESTIGATIONS INTO THE TEMPERATURE COMPENSATION PROCESSES IN THE BOTTOM PLENUM OF THE SNR-300 DURING EMERGENCY COOLING. Brukx, J.; Hansen, G.; Voj, P. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). 1975. 25p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

For the mathematical treatment of the tank internal emergency cooling in the SNR-300, the computer code NOTUNG is used. To protect the NOTUNG part which deals with the processes in the bottom plenum, the essential thermohydraulic phenomena occurring in the bottom plenum during the start-up phase of the emergency cooling process were investigated in model experiments. The HIVUP program separated from NOTUNG was used to recalculate the experimental results. The results of the recalculations showed that the description of the heat transfer to the flow apron is of particular importance in order to predict the time dependent temperature distribution. (GE)

10767 (AED-CONF-75-003-016) THERMAL DESIGN CALCULATIONS FOR THE EMERGENCY CORE COOLING SYSTEM OF THE SNR-300. Roesgen, F.; Timmermann, F.; Vossebrecker, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). 1975. 39p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

The after-heat of the SNR-300 as a rule, and that also applies to most accidents, is removed by the main cooling circuit chains. Furthermore, the SNR has an emergency core cooling system whose construction and mode of operation are described. It comes into use in serious accidents where due to external effects all main heat sinks fail. Furthermore, with this system, accidents may be controlled in which the primary cycles are separated due to the emergency level in the reactor vessel falling short. (GE)

10768 (AED-CONF-75-023-002) PREDICTION OF PHYSICAL CHARACTERISTICS FOR THE LONG-TERM BEHAVIOR OF FAST REACTORS. Helm, F.; Spenke, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). 1975. 19p. (In German). INIS.

From KTG-special meeting "long-term behaviour"; Stuttgart, F. R. Germany (25 Feb 1975).

In the prediction of physical parameters for the longtime behaviour of fast reactors a prediction improvement is desirable especially for the burnup reactivity and the breeding ratio. In the field of reactivity coefficients additional experiments in realistic geometries and with well simulated compositions can raise the prediction accuracy for spent fuels and facilitate the safety engineering design. (GE)

10769 (AI-AEC-13143) SODIUM TECHNOLOGY AND COVER GAS SEAL DEVELOPMENT PROGRAMS. Quarterly Technical Progress Report, October–December 1974. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Feb 1974. Contract AT(04-3)-824. 158p. AT.

Progress made in the development and testing of techniques and procedures for the cleaning, storage, and requalification of LMFBR coolant loop components is reported. Friction test data on FFTF material are presented. The testing of cover gas seals for LMFBR and FFTF cooling systems is described. (DG)

10770 (AI-AEC-13146) PERMEATION, LEAKAGE, AND COMPRESSION SET TESTING OF ELASTOMERIC SEALS FOR LMFBR USE. Kurzeka, W. J.; Welch, F. H. (Atomics International Div., Canoga Park, Calif. (USA)). 2 Apr 1975. Contract AT(04-3)-824. 91p. AT.

Elastomer seals were evaluated to FFTF/LMFBR conditions. Basic permeation measurements of the elastomers were conducted and compression set measurements of O-rings were made. Permeation measurements on static O-rings were made at various compressions and finishes. Dynamic Quad-, Q-, and T-seal leakage, permeation, and wear at various compressions and finishes were evaluated. (auth)

10771 (ANL-CT-75-34) VIBRATIONS OF A ROW OF CIRCULAR CYLINDERS IN A LIQUID. Chen, S. S. (Argonne National Lab., Ill. (USA)). Apr 1975. Contract W-31-109-Eng-38. 41p. Dep. NTIS $5.25.

The effects of interaction with surrounding liquid on the dynamic behavior of a row of circular cylinders are studied analytically. First, the hydrodynamic forces associated with cylinder motions are obtained using the potential flow theory. Then, a method of solution is presented for free vibration of a row of cylinders. Finally, steady state responses to harmonic excitations are presented. The results of the study have important application in the modeling of crossflow-induced vibration of heat-exchanger tubes. (auth)

10772 (CEA-CONF-2939) USE OF W–Re (5%Re; 26%Re) THERMOCOUPLES FOR THE STUDY OF NUCLEAR FUELS. Combette, P.; Faugere, J. L.; Schley, R.; Stora, J. P.; Lucot, M.; Lierman, J.; Gentil, J.; Aujollet, J.-P. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. de Technologie). 1974. 21p. (In French). INIS.

From international colloquium on high-temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

The technology of thermocouples used in the U and Pu fuel elements of fast neutron reactors is reviewed with special reference to their implantation inside the fissile column. The results obtained are described. (FR)

10773 (CONF-750607-7) POTENTIAL ALTERNATE SECONDARY SYSTEM FLUIDS FOR LMFBRs. Cooper, M. H.; Lee, P. K. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). [nd]. 6p. Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The feasibility of mitigating potential sodium-water reactions in LMFBR steam generators by substitution of a less reactive fluid in the secondary coolant loop is investigated. Thermal/hydraulic performance of potential fluids, including liquid elements, molten salts, gases, dissociating gases, organics, and fluid-solid suspensions, are evaluated using a digital computer program to compare heat transfer areas and pumping powers required for a 1300 MW(t) steam generator with sodium as the reference. Other factors evaluated are reactivity with sodium and water, materials compatability, thermal and radioactive stability, and toxicity. The results of the evaluations are summarized. No fluid was found to satisfy all of the requirements for an alternate high temperature LMFBR secondary system coolant. (auth)

10774 (CONF-750617-11) CONSTITUTIVE EQUATIONS FOR CREEP ANALYSIS OF LMFBR COMPONENTS. Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). 11 Mar 1975. 47p. Dep. NTIS $5.50.

From second ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

The analytical creep model (constitutive equations) that is presently used in design creep analyses of LMFBR components made of types 304 and 316 stainless steel and 2¼ Cr–1 Mo steel is described. Multiaxial equations are given and fully described in terms of their application to variable loading conditions. Methods of analysis for cyclic creep loadings is given special attention, and auxiliary rules are provided. A discussion is given of the mechanical properties data required to implement a design analysis along with comments on the impact of certain mathematical representations of such data. The ability of the indicated creep formulation to predict material behavior is illustrated through comparisons between analytical results and data from a variety of tests for type 304 stainless steel and 2¼ Cr–1 Mo steel specimens. The types of tests considered include stepwise increasing uniaxial stress creep tests, cyclic load creep tests, combined tension-torsion creep tests, and constant-strain relaxation tests. (auth)

10775 (COO-2245-15) COOLANT MIXING IN LMFBR ROD BUNDLES AND OUTLET PLENUM MIXING TRANSIENTS. Progress Report, December 1, 1974–February 28, 1975. Todreas, N. E.; Golay, M. W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1975. Contract AT (11-1)-2245. 33p. Dep. NTIS $4.00.

Progress is reported in the areas of bundle geometry (wrapped and bare rods), subchannel geometry (bare rods), and LMFBR outlet plenum flow mixing. (DG)

10776 (ERDA-38) LMFBR: ITS NEED AND TIMING. Discussion of the need to continue timely LMFBR Development, Including Comments on "Bypassing the Breeder" by NRDC. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). 20 May 1975. 140p. Dep. NTIS $10.00.

The electric power situation today and as predicted for the future is analyzed. An economic assessment of the LMFBR program is summarized. The comments of the Natural Resources Defense Council in "Bypassing the Breeder" are examined point by point. (JWR)

10777 (ERDA-tr-26) LEAK DETECTION IN FAST NEUTRON REACTOR STEAM GENERATORS. Subbotin, V. I.; Kozlov, F. A.; Kunetsov, E. K.; Kozub, P. S.; Baklushin, R. P.; Vasilenko, K. T. Jan 1975. Translated from Proceedings of the U. S./USSR Seminar on the Development of Sodium Cooled Fast Breeder Reactor Steam Generators, Vol. I., Los Angeles, California., December 2–4, 1974. (CONF-741236–1). 27p. Dep. NTIS $4.50.

From proceedings of the U. S./USSR on the development of sodium cooled fast breeder reactor steam generators; Los Angeles, California, USA (2 Dec 1974).

Requirements for steam generator leak detection systems in fast neutron reactor installations are discussed. Examples discussed are leak detection in BN-350 steam generators by analysis of hydrogen in the cover gas of the evaporators and leak detection systems utilizing hydrogen concentration control in sodium by means of a diffusion membrane with argon flow. Also presented are calculational evaluations of the efficiency of such systems conforming to BN-350 secondary system parameters. In discussing leak detection system requirements, primary attention is paid to the results of research on small leaks. Some data on the application of an acoustic method for leak detection obtained under laboratory conditions and on parameters of an improved device for hydrogen control in sodium with the use of an ion pump are given. (auth)

10778 (EURFNR-1251) SOME CONSIDERATIONS ON NEUTRON INSTRUMENTATION REQUIREMENTS FOR MALFUNCTION DIAGNOSIS IN POWER REACTORS USING NOISE ANALYSIS TECHNIQUES. Edelmann, M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Oct 1974. Translation of KFK–2088. (CONF-741065-46). 32p. Dep. NTIS (US Sales Only) $4.75.

From EACRP specialist meeting on reactor noise from critical facilities to power plants; Rome, Italy (21 Oct 1974).

Work performed under United States–Euratom Fast Reactor Exchange Program.

To determine the response of a neutron detector to local perturbations in a typical fast breeder reactor, detailed numerical calculations of space-dependent source transfer functions were performed for the German prototype reactor SNR 300. The small local reactivity perturbations considered here were replaced by a neutron source modulation for simplicity reasons. The source transfer function was obtained from the Laplace transform of the time-dependent inhomogeneous diffusion equation. The 26 group KFK-INR cross section set and one-dimensional cylinder geometry were used for the numerical solution of the diffusion equation in the frequency domain. The detector was treated as an integral part of the reactor. The detector materials B-10, U-235 and Pu-239 were chosen for comparison. The positions of source and detector were independently varied within the core and blanket of the reactor. From the space-dependent transfer function of the reactor-detector system and the general theory, relating power spectral densities of neutron detector signals and reactivity perturbations for the point reactor model, the neutron instrumentation requirements for detecting local perturbations in a fast reactor were deduced. It was found that in the present class of fast breeder prototype reactors no in-core neutron detectors will be needed for a continuous inspection using noise analysis techniques to detect local perturbations. (auth)

10779 (GA-A-13329) NEUTRON-COUPLED GAMMA-RAY CROSS-SECTION REQUIREMENTS FOR GAS-COOLED FAST BREEDER REACTORS. Nagel, M.; Cerbone, R. J. (General Atomic Co., San Diego, Calif. (USA)). 12 Mar 1975. Contract AT(04-3)-167. 12p. (CONF-750303-66). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The Gas-Cooled Fast Breeder Reactor (GCFR) operates in the $(Pu,U)O_2$ fuel cycle in the core and axial blanket and in either the $(Pu,U)O_2$ or the Th-^{233}U fuel cycle in the radial blanket. The core, blanket, shielding, and primary system components (helium circulators, steam generators, etc.) are enclosed in a prestressed concrete reactor vessel (PCRV). The primary purpose of the GCFR shielding is to protect the primary components and the PCRV from excessive exposure to radiation. Biological shielding is not a primary consideration because ample protection is provided by the concrete mass of the PCRV. Hence, the three major shielding functions are (1) to limit the rate of radiation-induced heat deposition in the PCRV concrete, (2) to limit fast-neutron-induced damage to vital structural components, including the PCRV liner and the reactor grid plate, and (3) to limit neutron-induced activation of the primary system components. Neutron-induced secondary gamma-rays are the primary source of heat in the shielding and PCRV. The methods used in calculating neutron-induced gamma-ray heating are described. (auth)

10780 (GEAP-13771-13) CRITICAL EXPERIMENTS AND ANALYSIS. Thirteenth Quarterly Report, October–December 1974. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jan 1975. Contract AT(04-3)-893. 74p. AT.

Current activities and technical progress for the period October through December 1974 are reported for two subtasks. Subtask A covers the technical direction for critical experiments and analysis as applicable to LMFBR commercial plants and the Clinch River Breeder Reactor Plant Benchmark Critical Experiments in ZPPR Assembly 4 and the CRBRP EMC. Subtask B is directed toward the development of LMFBR plant calculational methods that also can be used at the sites of the Clinch River Breeder Reactor to determine the reactor power distribution, reactivity and fuel status, and for consideration of alternative fuel and control management schemes. (auth)

10781 (GU-5306) TOPICAL REPORT: FAST REACTOR MIXED CARBIDE FUEL ELEMENT DEVELOPMENT PROGRAM, Sodium Bonded Uranium Plutonium Carbide Fuel Rods Irradiated to 46,000 Mwd/T. Montgomery, M. H.; Strasser, A. A.; Andersen, J. C.; Grando, C. (Gulf United Nuclear Fuels Corp., Elmsford, N. Y. (USA)). Nov 1973. Contract AT(11-1)-3059. 67p. Dep. NTIS $4.00.

A description is given of an irradiation program to demonstrate the performance of sodium-bonded fuel rods for high irradiation exposures. In particular, the program will test the compatibility between fuel-sodium-clad, the ability of a sodium bond to accommodate fuel swelling, and the integrity of the sodium bond over long periods of time at high heat fluxes. Four sodium-bonded uranium–plutonium carbide fuel rods typical of those for an LMFBR were irradiated to a peak burnup of 46,000 MWd/T at 820 W/cm (25 kW/ft) in the V-RAFT facilities of the GETR in instrumented heater controlled capsules. The post-irradiation examination was made at Los Alamos Scientific Laboratory. The design variables and the examination results are summarized. (auth)

10782 (IAEA-166, pp 21-31) METHOD OF CALCULATION OF HOT CHANNEL FACTORS FOR FAST REACTOR FUEL ELEMENTS. Krasnoyarov, N. V. 1974. (In Russian).

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karlsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

10783 (IAEA-166, pp 33-80) CONSIDERATION ON SAFETY MARGIN IN JOYO THERMAL DESIGN. Inoue, T.; Yoshino, F.; Izumi, A. 1974.

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

This report gives an outline of core system related with the thermal design of JOYO and, as design policy, an explanation on the special circumstances characteristic to JOYO and outlines of considerations made regarding power peaking factors and safety margin, both of which are vital in the thermal design. Meantime the method of selecting factors for individual safety margin, its treatment and concrete value and the reasons for considering such safety margin are also discussed in detail. Survey study was performed on the hot spot analysis by considering various methods of treatment. The values of individual safety factor were decided, taking into consideration the results of various confirmation tests regarding performance of the reactor core, embodiment of design specifications and evaluation of design data. (auth)

10784 (IAEA-166, pp 81-84) A SIMPLE PROCEDURE FOR THE COMBINATION OF FUEL PIN, SUB-ASSEMBLY AND REACTOR UNCERTAINTIES IN FAST REACTOR CLAD HOT SPOT TEMPERATURE ASSESSMENT. Linning, D. L. 1974.

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karlsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

It is postulated that the hot-spot margin can be regarded as consisting of two components. The first component of the margin is the temperature deviation required to ensure that out of a population of nominally identical fuel pins not more than a spec-

ified number will be outside that deviation. An approximation is introduced here in combining pin and sub-assembly uncertainties to produce a combined uncertainty by adding variances. The second component of the hot-spot margin is the temperature differential required to insure against an adverse reactor contribution. It is, therefore, simply the margin which provides that only one in so many reactors is likely to produce a deviation which could raise above the acceptable limit the number of pins at risk of exceeding the hot-spot limit. (auth)

10785 (IAEA-166, pp 85-105) HOT-SPOT ANALYSIS PROCEDURES FOR FAST REACTORS. Linning, D. L.; McAreavey, G.; Rowlinson, B. 1974.

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karlsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

The end product of the hot-spot analysis procedures described is a graph showing the relationship between measured mixed mean outlet temperature and the maximum number of pins at some small specified risk of exceeding the hot-spot limit. To arrive at this position, it is necessary to take account of (1) the variation of clad temperature with burnup; (2) the variation of initial clad temperature throughout the core due to transverse flux gradients; (3) the problem of combining three categories of uncertainty associated with pins, sub-assemblies and reactors, respectively. The first problem is resolved by one of two options involving either the use of a single temperature representative of clad temperature history or a burnup dependent hot spot limit. The second problem is resolved by putting all pins in any small temperature interval in the same population, and treating each sub-population separately. The third problem is dealt with by a procedure which is described in the comparison paper, "A Simple Procedure for the Combination of Fuel Pin, Sub-Assembly and Reactor Uncertainties in Fast Reactor Clad Hot-Spot Temperature Assessment." (auth)

10786 (IAEA-166, pp 107-110) THE OBJECTIVES OF DESIGN STAGE HOT-SPOT ANALYSIS. Gatley, J. A. 1974.

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karlsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

The fundamental objective in designing a commercial fast reactor is to produce a power station which can generate a certain electrical output power without exceeding any of the defined operational limits. The limit of first interest for core design is the hotspot criterion. It is advantageous to increase the maximum fuel burnup and, usually, the maximum fuel can temperatures. The extent to which these objectives can be achieved is limited by the incidence of failed fuel pins, and the calculational technique should therefore be capable of being related to failed pin frequencies. Two calculational approaches are discussed: the first extrapolates pin conditions to obtain a "representative temperature" at a notional target burnup, which is used for assessing the probability of certain numbers of pins failing before reaching that burnup; and the second concentrates on the degree of risk of having failed pins actually present in the reactor at any particular time of interest. This is referred to as the "instantaneous" approach. The form of hotspot limiting criterion used depends on the approach used. It is pointed out that any calculation should be relatable to early irradiation data and should be able to accommodate practical variations in fuel cycle and gagging policy. (auth)

10787 (IAEA-166, pp 111-118) THE ADVANCES STATISTICAL HOT SPOT ANALYSIS IN GAS BREEDER REACTORS. Franken, W. M. P. 1974.

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karlsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

The hot spot analysis on a pintype, gas-cooled breeder reactor has been the subject of this study. In this reactor type one has to expect a rather great temperature difference between the cladding and the coolant by the poor heat transfer behavior of the gas. Furthermore, to decrease the nominal wall temperature, the heat transfer is increased over a substantial part of the core by the presence of artificial wall roughness on the cladding. The role of the local uncertainties, acting on the temperature difference between cladding and gas, is an important factor in the cladding hot spot calculations. Extra local uncertainties, due to tolerances in the roughness geometry, have to be taken into account only in the roughened part of the core. To introduce in the hot spot analysis these specific features of gas breeder reactors the advanced statistical method of A. Amendola has been adopted and the necessary modifications in the computer code SHOSPA have been introduced, so that the new version of the code now applies to both sodium and gas cooled breeder reactors. Some calculations on a reference core have been performed to study the influence of the roughened length on the cladding hot spot factor. It followed that one can get a considerable gain in cladding hot spot temperature by taking the roughened length slightly greater than the value at which equal nominal peak-temperatures appear in the smooth and the roughened part of the core. (auth)

10788 (IAEA-166, pp 119-130) HOT-SPOT COMPUTATIONAL METHOD PROPOSED FOR THE START-UP OF PHENIX. Skok, J. 1974. (In French).

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karlsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

10789 (IAEA-166, pp 133-142) HOT CHANNEL CALCULATIONS FOR THE PEC REACTOR CORE. Part 1 of CNEN Activities on the Thermal Design of Fast Reactor Fuel Elements (Status Report). Amelotti, F.; Barbaro, M.; Spagna, F. 1974.

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karlsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

This report reviews the CNEN activities on the thermal design of fast reactor fuel elements, carried out in the framework of the Italian Fast Reactor Program (PRV). The first part of the report deals with the status of the thermal design of the PEC fast reactor core and with the experience gained at PRV upon some hot channel analysis methods. Hot channel calculations for the EPEC-4 (UO_2 fueled) core concept are presented. The results of two methods for the combination of the uncertainties (semistatistical and SHOSPA) are compared. Guidelines for thermal analysis of a mixed oxide core concept (EPEC-5), now under investigation, are discussed. (INIS)

10790 (IAEA-166, pp 143-159) SODIUM OUT-OF-PILE EXPERIMENTS PERFORMED AT USTS/N IN SUPPORT OF PEC FUEL ELEMENTS THERMAL DESIGN. Part 2 of CNEN Activities of the Thermal Design of Fast Reactor Fuel Elements (Status Report). Iannuzzo, P.; Falzetti, L.; Martini, M. 1974.

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karlsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

This report reviews the CNEN activities on the thermal design of fast reactor fuel elements carried out in the framework of the Italian Fast Reactor Program (PRV). The second part deals with the status of the experimental program in support of the thermal design, carried out at USTS, Casaccia. The principal features of the planned sodium thermohydraulic and thermomechanical tests on highly instrumented fuel element partial mock-ups (unheated and heated rod bundles) are reviewed. Preliminary results, mainly concerned with test section design, characterization and instrumentation, are presented. (INIS)

10791 (PMC-74-02) PROPOSED REFERENCE DESIGN FOR THE CLINCH RIVER BREEDER REACTOR PLANT. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). 1974. 101p. (CONF-741087-). AT.

Included are project status overviews, reference design data for reactor systems and balance-of-plant, plant layout and construction planning, safety features and licensing activities, cost estimates, and project schedules. The AEC Environmental Impact Statement for the LMFBR program is discussed, and cost-benefit data are presented. (DG)

10792 (WARD-RB-3045-7) RADIAL BLANKET DESIGN AND DEVELOPMENT. Quarterly Progress Report for Period Ending August 31, 1974. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). May 1975. Contract E(11-1)-3045. 82p. AT.

Design of the 61-rod test section was continued. A thermocouple instrument plan for the 61-rod test section was prepared. Layouts were prepared for alternate duct designs to provide a basis for initiating procurement. Design and analysis of the auxiliary ducts and heaters which provide the means for simulating interassembly heat transfer was pursued. Seventeen heater rods and 12 wire-wrap thermocouples for the 7-rod test section were received from the manufacturers. Inspection, characterization, and preassembly of 12 of the heaters was completed and rods released for wire wrapping and assembly into the bundle. During this quarter, the rod irradiation test assembly in EBR-II (WBA-20) accumulated 3140 megawatt days with a total accumulated peak fluence of 1.1×10^{22} n/cm^2. Planning and design of a radial blanket assembly irradiation test in FTR was initiated. Basic objectives and design requirements were identified. Layout drawings of the fuel rod and an assembly which can be installed in FTR were started. Initial orifice arrangement and design parameters were defined based upon available data. In addition, the hydraulic resistances to be mocked-up in the dummy blanket and core assemblies were determined. Design layouts for the orifice calibration test rig and for the full-size lower core support structure module test rig were prepared and are being reviewed. (auth)

10793 FAST BREEDER REACTORS. Traube, K. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)); Guthmann, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Kompakte Natriumgekuehlte Kernreaktoranlage). Elektrotech. Z., A; 96: No. 1, 19-23(1975). (In German).

The typical characteristics of sodium influence the technical concept of LMFBR type reactors. KNK, which operated successfully with its first thermal core, will be equipped with a fast core in 1975. The 300 MW prototype SNR is under construction at Kalkar. The preliminary design for the first large power station, SNR 2, which shall be built 1980 with international cooperation, is underway. (auth)

10794 EVALUATION OF THE STABILIZATION OF POWER DENSITY DISTRIBUTION IN HIGH-POWER FAST REACTORS. Ilyunin, V. G.; Kuz'min, A. M.; Murogov, V. M.; Orlov, V. V.; Silaev, Yu. V.; Troyanov, M. F.; Smelev, A. N.; Yurova, L. N. (Physikalisch-Energetisches Institut, Obninsk, USSR). Kernenergie; 18: No. 3, 61-64(1975). (In German).

The drawbacks due to non-uniformity of power density distribution are quantitatively evaluated, and the advantages of stabilizing the power density distribution during operation of an oxide-fuelled sodium-cooled 1500 MW(e) high-power fast reactor are shown. (auth)

10795 NUCLEAR REACTORS. Gratton, C. P.; Hoper, A. T.; Kenward, A. (to United Kingdom Atomic Energy Authority). US Patent 3,867,253. 18 Feb 1975. Filed date 6 Oct 1971. 8p.

In a nuclear reactor employing porous fuel, irregularities of coolant flow can occur through the porous fuel at different parts of the core. According to the present invention means are provided to lessen the nonuniformity of coolant flow and typically sleeves with control orifices in their walls are employed to regulate the coolant flow through porous fuel tubes. (5 claims, 5 drawing figures) (Official Gazette)

10796 FAST BREEDER REACTORS. Nucleonic Week Special Report. New York; McGraw-Hill, Inc. (1974). 22p. $25.00.

News items concerning fast breeder reactors selected from 1974 issues of Nucleonics Week are presented. (JWR)

10797 EFFECTS OF THE HIGHER PLUTONIUM ISOTOPES AND THE IMPLICATIONS OF THE UNCERTAINTIES IN THEIR NUCLEAR DATA ON FAST REACTOR DESIGN. McKnight, R. D. Cincinnati; Univ. of Cincinnati (1974). 248p. University Microfilms Order No. 75-9038.

Thesis (Ph.D.).

The sensitivity of fast reactor design parameters to nuclear data uncertainties is investigated. Based on a review of the available cross section literature, the uncertainties in the cross sections of ^{240}Pu, ^{241}Pu, and ^{242}Pu, as well as ^{239}Pu and ^{238}U, are evaluated. The effects of these cross section uncertainties upon beginning-of-life physics parameters and long-term fuel cycle characteristics are assessed by making uniform cross section adjustments within the range of uncertainties. The reactor model selected for this study is representative of current designs of a 1000 MWe mixed-(Pu,U) oxide-fueled fast breeder reactor. ENDF/B Version III data are used for a data reference. A series of one-dimensional multigroup diffusion-perturbation calculations is performed to study the sensitivity of beginning-of-life reactor design parameters, including eigenvalue, Doppler and sodium void reactivity coefficients, breeding ratio, material worths, reaction rates, power fractions and fissile mass inventory. The results of these sensitivity calculations are compared with target accuracies for calculation of reactor parameters. These parameter sensitivities are further used to estimate the nuclear data uncertainties which would be allowable to meet the target accuracies. A series of reactor burnup calculations evaluate the sensitivity of fuel cycle characteristics during the approach to equilibrium conditions. The effects of nuclear data uncertainties upon the time-variation of the breeding ratio, doubling time, power distribution, fissile loading, fissile mass discharge rates, control requirements, and reactivity swing are evaluated. The reference fuel cycle calculations are also used to assess the plutonium isotopic composition discharged from the equilibrium cycle of a first-generation fast breeder reactor. The most significant isotopic change in the approach to equilibrium cycle is the depletion of the ^{241}Pu to one-half its initial (light-water reactor discharge) concentration. The results of these sensitivity calculations represent a general overview of the nuclear data requirements for fast reactor design. The most important nuclear data, that is, the ^{239}Pu fission and ^{238}U capture cross sections, must be determined within 1 to 2 percent. With respect to the higher plutonium isotopes, the principal data requirement is the evaluation of the fission cross section of ^{241}Pu within 4 to 5 percent. The ^{240}Pu cross sections should be determined within 10 percent and the ^{242}Pu cross sections within 20 percent. (Diss. Abstr. Int., B)

Research, Test, and Experimental Reactors

Refer also to abstracts 10769, 10936, and 11124.

10798 (CEA-N-1777) IDENTIFICATION OF THE MODEL OF ULYSSE REACTOR USING DYNAMICAL TESTS. Zwingelstein, G.; Blanc, P.; Poujol, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Services d'Electronique). 29 Oct 1974. 32p. (In French). (CEA-SES-PUB-SAI-74-195). INIS.

Dynamic test experiments are described the aim being identify a model connecting the reactivity injected by the control rod and the neutronic power of the reactor Ulysse. An analog signal was injected to the rod control mechanism through a specialized interface. The neutron flux variations were measured by a CC5 current chamber connected to a measurement line. The model of the reactor Ulysse was identified in particular, although its integrating nature gives it great instability. (FR)

10799 (CONF-750607-8) TRANSPORT/DIFFUSION COMPARISON FOR THE FFTF ENGINEERING. Flanagan, G. F.; Selby, D. L. (Oak Ridge National Lab., Tenn. (USA)). 1974. 5p. Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

In the current designs of fast reactors, the control monitoring during subcritical and low power operation will be based on data from ex-core detectors. These detectors are located in the radial shield of the Fast Flux Test Facility (FFTF) at approximately 113 cm from the core center. Fluxes in the area of the detectors are anisotropic and, therefore, the detector reaction rates could prove expensive to calculate. A large scale reactivity measurement experiment with the FFTF engineering mock-up critical core loaded into the ZPR-9 facility at Argonne National Laboratory was conducted in order to determine the adequacy of the low-level flux monitoring (LLFM) system in predicting the reactivity. (auth)

10800 (IAEA-166, pp 161-188) APPLICATION OF HOT CHANNEL ANALYSIS TO KNK-II. Schaefer, H.; Klassmann, W. 1974.

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karlsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

By means of the codes STAR and TRIBUT, whose principles are shortly described, a statistical uncertainty analysis can be performed. It is shown that in the KNK-II core the two design limits (max. linear power and max. sodium temperature at core outlet) will not be exceeded with high probability. Concerning linear power, a given nominal power distribution is assumed and the probability that no pellet exceeds the limit is calculated. The

limit is taken as a parameter in order to compare the codes and to weight the influences of different types of uncertainty distribution functions. Additionally, the pellets are classified in the range of high linear power and the probability distribution function of the pellets in excess of a limit of the linear power is determined. Concerning sodium temperature at core outlet, global probability that all the channel temperatures of the considered reactor zone will be below the design limit is assumed. However, in order to determine the nominal temperature distribution, there has to be an additional criterion—how to link the individual temperature levels of the subassemblies together. Three criteria have been studied; their influences on the nominal temperature levels of the subassemblies and on the core data are evaluated. (auth)

10801 (KFK-2095) ANALYSIS OF SEFOR EXPERIMENTS. Bogensberger, H. G.; Caldarola, L.; Mitzel, F.; Oosterkamp, W. J.; Wintzer, D. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Jan 1975. 115p. (EUR-5200e). Dep. NTIS (US Sales Only) $8.75.

Methods and results of the analysis of several SEFOR zero power and power experiments are presented. With few exceptions, the analysis of zero power experiments confirms experiences which had been obtained by more simple zero power assemblies for the more recent GfK cross section sets and calculational methods. The Doppler temperature coefficients as evaluated from several SEFOR Doppler experiments are in good agreement with GE results, although evaluation methods differ in several details. The evaluated Doppler temperature coefficients are slightly overestimated by nuclear calculations. However, the overestimation is within the estimated uncertainties of the evaluations from experiments. (auth)

10802 (KFK-EXT-7/74-1) EXPERIMENTAL AND COMPUTATIONAL INVESTIGATIONS ON THE OPERATING BEHAVIOR OF THE FUEL ELEMENT OF THE HIGH FLUX REACTOR GRENOBLE. Ihle, P.; Malang, S.; Politzky, H. M.; Rust, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorbauelemente). Feb 1975. 89p. (In German). Dep. NTIS (US Sales Only) $7.50.

The German-French High Flux Reactor in Grenoble is a research reactor with a very compact core design producing high neutron and power densities. To examine the operating behavior and the safety of the fuel element investigations were carried out at the Gesellschaft für Kernforschung by order of the Max von Laue–Paul Langevin Institute. The following problems were investigated: (1) Hydrodynamic experiments to determine the influence of geometrical parameters of the fuel element on the operating behavior of the core; (2) Computational investigations of possible consequences due to inhomogeneities in the distribution of the fissile material; and (3) Theoretical considerations of the temperature fields at exposed points of the fuel element plates. A fuel element true to specification was available and was installed in a water loop to study the mass flow in the individual coolant channels, the pressure drop and the hydrodynamic load to the welded assembly of the fuel plates. The results of the experiments are discussed. (auth)

10803 (KURRI-TR-124) LONG LIFE RADIOACTIVE NUCLIDES IN THE KUR COOLING WATER AND WASTE WATER USED FOR REGENERATION OF ION EXCHANGE RESIN FOR PURIFYING THE WATER. Kimura, S.; Yokochi, A.; Tsutsui, T. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). 1974. 24p. (In Japanese). Dep. NTIS (US Sales Only) $4.25.

Radioactive nuclides in the reactor cooling water are concentrated in the ion exchange tower. Resins saturated by radioactive nuclides are regenerated at desired times. Consequently, large amounts of radioactive waste water are obtained. This waste water has high concentration of salts, and it is difficult to treat. In order to efficiently treat the waste water, the kinds of radioactive nuclides present in the waste water prior to the treatment must be known. Long life radioactive nuclides in the cooling water and waste water were identified by the γ-ray spectroscopy. Nuclides detected are as follows: ^{65}Zn, ^{141}Ce, ^{124}Sb, ^{51}Cr, and ^{137}Cs in the cooling water, and ^{137}Cs, $^{95}Zr-Nb$, ^{144}Ce, ^{51}Cr, ^{60}Co, and ^{65}Zn in the waste water used for regeneration of resin. (auth)

10804 (KURRI-TR-128) EXPERIMENTAL STUDY OF THE PRODUCTION OF HOT NEUTRONS FROM A PILE OF SiC. Okumura, K.; Matsumoto, T. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). 1970. 14p. (In Japanese). Dep. NTIS (US Sales Only) $4.00.

The usefulness of SiC is discussed as a hot pile material in which are produced hot neutrons with higher energy than about 0.05 eV. The experiment consists of the measurement of the neutron spectrum from the SiC pile at various temperatures (up to 1100°C) and the measurement of the total cross section of SiC at room temperature. The former is obtained by the time of flight method using a fast chopper placed at the thermal column of KUR and the latter by using Linac pulsed neutrons. The neutron spectrum from the hot pile at various temperatures is reduced to a relation of the gain of hot neutrons and temperatures of the pile as a variable of energy. Furthermore the correspondence is discussed between the neutron spectrum from the hot pile and total cross section. (auth)

10805 (LA-5933-MS) FTRCOL: A COMPUTER CODE TO GROUP COLLAPSE FTR FILES AND OUTPUT STANDARD CCCC INTERFACE FILES. Soran, P. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1975. Contract W-7405-eng-36. 54p. Dep. NTIS $5.45.

FTRCOL takes multigroups cross sections and resonance self-shielding factors structured in an FTR format and collapses to fewer groups. FTRCOL produces version III standard ISOTXS and BRKOXS interface files. The 1/E + fission spectrum has optional energy cut points and theta values and uses an adaptive integration technique to produce the fine group fluxes. Two system input/output units and six input/output units are required. All calculations are performed and stored in small core. (auth)

10806 (LIB/TRANS-556) RAISING THE FOUR DOWNCOMERS IN THE REACTOR ALUMINIUM TANK OF THE FRJ-2 RESEARCH REACTOR AS AN EXAMPLE OF THE EXECUTION OF COMPLICATED WORK IN THE REGION OF HIGH RADIATION LEVELS. Nickel, M.; Schmitz, J.; Wolters, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Forschungsreaktoren). Feb 1975. Translation by J. B. Hopkinson of JUL–1014-RE. 57p. Dep. NTIS (US Sales Only) $6.00.

As a result of the planned power increase from 15 MW to 25 MW, a new emergency cooling system had to be installed in the research reactor FRJ-2 of the KFA Juelich, which called for an extension of the four standpipes in the reactor tank by 57 mm. Due to the high radiation level in the reactor tank, new techniques had to be found allowing aluminium rings of corresponding height to be welded onto the top part of the standpipes by remote-controlled welding; moreover, the welded parts were then to be protected by a bandage made of high-quality steel. The development work was carried out in the KFA and this report gives an account of the technique applied and the results obtained. (auth)

10807 (LIB/TRANS-561) ROUTINE TESTS OF RESEARCH REACTORS. Recommendations on Periodic Safety Tests of Research Reactors. Guidelines and Recommendations. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs–Vereine e. V., Koeln (F. R. Germany)). Mar 1975. Translation by A. Bicevskis of IRS-R-3. 18p. Dep. NTIS (US Sales Only) $4.00.

The recommended version of the guidelines to be consulted for licensing and supervisory purposes is presented. This version has been discussed by the subcommittee on nuclear plants of the Committee of the Laender on nuclear energy on September 23, 1973 and has been worked out originally on behalf of the then Federal Ministry for Education and Science by the "Arbeitsgemeinschaft fuer Betriebs- und Sicherheitsfragen an Forschungsreaktoren" (task group for operational and safety problems of research reactors), the TUEVs (Technical Surveillance Associations) and the IRS (Institute for Reactor Safety, Cologne). (auth)

10808 (ORNL-TM-4906) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT JULY, AUGUST, AND SEPTEMBER 1974. Hurt, S. S. III; Lance, E. D. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 33p. Dep. NTIS $4.75.

The ORR operated at an average power level of 28.9 MW for 69.4% of the time during July, August, and September of 1974. Twelve fuel elements were declared spent (51.2% average burnup) during the quarter, while fifteen new elements were placed in service. Four shim-rod elements were retired from service at an average burnup of 60.7%. The reactor was shut down on seventeen occasions, six of which were unscheduled. Two end-of-cycle shutdowns accounted for 28.1% of the total downtime. This percent is unusually low for the end-of-cycle shutdown time due to 55.5% of the total downtime being necessary for the retrieval of an irradiated iodine sleeve which was accidentally flushed from the reactor core into a cooling water pump. The remaining downtime was used principally for refueling and experiment work. Maintenance activity, both mechanical and instrument, was essentially routine in nature. Special tests or measurements completed during the quarter included: (1) gamma heating and neutron flux measurements in core positions E-5 and E-7, (2) reactivity measurements of dummy experiments in core positions E-5 and E-7, and (3) reactivity comparison of 240 and 265 gram ORR fuel elements. (auth)

10809 PULSED REACTOR AND NEUTRON SPECTROSCOPY. Sarapov, E. I. Fiz. Szemle; 24: No. 7, 215-224(Jul 1974). (In Hungarian).

The core of the pulsed fast IBR reactor at Dubna consists of nearly pure ^{235}U and ^{240}Pu in three portions. The first fixed portion has a mass less than the critical one; the second is attached to the edge of a 1-m diameter disc rotating at 50 rpm while the third, also moving portion is attached to a wheel rotating at a lower rate. Criticality is achieved when the three masses are joined; at that time the reactor yields an about 60 microsecond pulse of about 10^{15} neutrons/sec. The relatively insignificant amount of heat released at the 25 kW rating is removed by air cooling. A novel system was developed, uniting the advantages of the reactor and of accelerators. The pulse operates only if external neutrons reach the core, thus functioning as a neutron multiplier. The duration of the pulse may be thus reduced to 3 microseconds at 10^{14} n/sec; this is a better solution than the mechanical chopper. The history of neutron spectroscopy is reviewed, indicating the application of pulsed neutrons. Use of slow neutrons for solid-state spectroscopy, time-of-flight spectrometry, application of neutron spectroscopy to the study of atomic models and new techniques developed with the improved IBR-30 reactor are described, mentioning the preparation of polarized proton targets, study of the magnetic dipole moments of compound nuclei which have not been measured previously. Of special interest is the investigation of ultracold neutrons which occupy only the 10^{-11} part of the Maxwellian distribution. A new, high-capacity reactor, the 4-MW(t) IBR-2 is being designed. (TTT)

Production and Materials Testing and Processing Reactors

10810 (DP-MS-75-2) COMPARISON OF MEASURED AND CALCULATED VOID REACTIVITY WORTHS. Ahlfeld, C. E.; Pryor, R. J. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 15p. (CONF-750607-12). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Void reactivity worths calculated by methods suitable for large moderator voids in heavy-water-moderated production reactors are compared with measured values for the Savannah River Process Development Pile. The experimental data form a useful set of benchmark cases to judge the quality of void calculations in large D_2O systems. A comparison of experimental and calculated results indicates that the calculational methods have general applicability to large D_2O systems. (JWR)

10811 NUCLEAR PROCESS HEAT FOR THE PRODUCTION OF HYDROGEN. Employment of Hydro-Cracking Plants. Eickhoff, H. G.; Kugeler, K. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Erdoel Kohle; 27: No. 9, 509-513 (Sep 1975). (In German).

The combination of a hydrocracker with a nuclear heated naphtha cracking plant for the conversion of heavier fractions into lighter ones and also the production of hydrogen is considered. A possible process arrangement and corresponding cost calculations are presented. Research is going on at the Nuclear Research Centre Juelich with a reactor using spherical fuel elements and with a helium heated methane-cracking unit. The results so far indicate that a commercial application is possible. (auth)

10812 POSSIBILITIES OF UTILIZATION OF NUCLEAR ENERGY. Chem. Lab. Betr.; No. 10, 451-452(Oct 1974). (In German).

Information is presented as to the utilization of nuclear power plants as suppliers of heat for industry and for district heating. (GE)

Propulsion and Package Reactors

Refer also to abstracts 9377, 11031–11032, 11053, 11057–11060, 11099, and 11102–11104.

10813 (AGC-0020) EVALUATION OF ANTICRITICALITY DESTRUCT SYSTEM CONCEPTS. Chamberlain, C. C. (ed.). (Aerojet-General Corp., Azusa, Calif. (USA)). 31 Dec 1963. 70p. Dep. NTIS $6.50.

Declassified 7 Dec 1973.

The Anti Criticality Destruct System (ACDS) is required to render the reactor essentially harmless in the event an accident to, or malfunction of, the NERVA engine occurs prior to its operation by dividing the reactor core into subcritical fragments, and dispersing these fragments so that none of the portions can combine in a geometry that could become critical in a moderating environment. A number of different ACDS concepts have been evaluated by performing tests of the various explosive systems against full-scale, simulated engine targets positioned on top of 10-ft-high test stands and oriented with the engine axis vertical. (auth)

10814 (AGC-0716-16(01)MP) NERVA ENGINE EXPLOSIVE DESTRUCT SYSTEM, SUBTASK 1.6. Monthly Progress Report for October 1962. (Aerojet-General Corp., Downey, Calif. (USA)). [nd]. 59p. Dep. NTIS $6.00.

Declassified 12 Sep 1973.

A series of explosive-fracture mechanisms tests are being planned. These tests will furnish information concerning: (1) test techniques, (2) effects of test-module confinement on fragmentation, and (3) ratios of graphite-to-explosive to achieve various ranges of fragment-size distributions. A dropweight fixture has been designed for use in mechanical-fracture testing. The use of sonic equipment in acoustical testing is being studied. Such tests would furnish knowledge of the basic structure of graphite at the density used in the reactor core. Planning for Phase 1 of the explosive irradiation program continued, with all responsible agencies participating. Five capsule test series were conducted as part of the capsule design and design evaluation effort. To date, the center-hole design appears the most feasible, and welding the assembly together was proved unfeasible. (auth)

10815 (AGC-0716-16(11)MP) NERVA ENGINE EXPLOSIVE DESTRUCT SYSTEM, SUBTASK 1.6. Monthly Progress Report for August 1963. (Aerojet-General Corp., Downey, Calif. (USA)). [nd]. 68p. Dep. NTIS $6.50.

Declassified 12 Sep 1973.

Before reactor operation an explosive destruct system has to fracture the reactor into subcritical masses and disperse these fragments so that they are not deposited in geometries capable of becoming critical in water or other moderator. After operation the core must be pulverized into particles less than 1/32 in. diameter so re-entry ablation will disperse fission product contamination. The status of fragmentation research is described. (LTN)

10816 (AGC-2200(Vol. 2)(App.)) NERVA ENGINE DEVELOPMENT PROGRAM AND ASSOCIATED TASKS. Volume II. NERVA Engine System. Appendix: Specifications. Final Report, July 10, 1961–January 10, 1962. (Aerojet-General Corp., Azusa, Calif. (USA)). Feb 1962. Contract AT(04-3)-44. 137p. Dep. NTIS $10.00.

Declassified 28 Aug 1973.

This specification establishes the requirements for the AJ30-5 Shielded Nuclear Rocket Engine, a liquid propellant, turbopump-fed, nuclear engine rated at 55,544 lb nominal vacuum thrust. The engine consists of a thrust chamber assembly, a turbopump assembly, connecting lines and fittings, components required for engine operation, and a supporting thrust structure for these assemblies. The thrust chamber consists of a pressure vessel enclosing a beryllium-reflected graphite core reactor; the reactor has an internal primary shield, a nozzle assembly, and a gimbal mechanism. The propellant utilized by the engine is liquid hydrogen. The turbine drive gas will be bled off ahead of the main nozzle throat and mixed with hot diluent bled from the core exhaust gas. In addition, the engine includes vector control and restart capability systems. The turbine will be accelerated during start, using gas generated from the heat capacity of the nozzle, reflector, shield and core. Tank pressure causes the initial flow of propellant through the engine; this pressure is supplemented by pump pressure rise as the turbopump accelerates. The AJ31-6 Shielded Nuclear Rocket Engine is similar to the above model but the turbine drive gas will be obtained from the upper reactor plenum and heated in the nozzle skirt. The turbine will be accelerated during start using gas generated from the heat capacity of the nozzle, reflector, and shield. Tank pressure causes the initial flow of propellant through the engine and this pressure is supplemented by pump pressure rise as the turbopump accelerates. (auth)

10817 (AGC-2273) RADIATION EFFECTS FACILITY SUMMARY REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1962. 46p. Dep. NTIS $5.50.

Declassified 11 Sep 1973.

Unlike chemical rockets, the development testing of nuclear rockets must include component and subassembly testing under conditions of nuclear radiation. Two facilities for conducting such radiation testing for the NERVA program are investigated from the standpoints of scheduling, experimental accuracy, experimental accuracy, experimental operation, and costs. (auth)

10818 (AGC-2274) RADIATION ANALYSIS ENGINE TEST STAND ETS-1. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1962. 56p. Dep. NTIS $6.00.

Declassified 11 Sep 1973.

The adequacy of the shielding design for the ETS-1 facility at NRDS has been reviewed. The operating requirements for ETS-1 were found to be consistent with the facility design. The environmental dose rates associated with the normal operation of ETS-1 are presented. The methods of analysis and the radiation source data are described in detail. (auth)

10819 (AGC-2276) ENGINE SYSTEMS DATA BOOK. (Aerojet-General Corp., Azusa, Calif. (USA)). Nov 1962. 517p. Dep. NTIS $29.00.

Declassified 7 Sep 1973.

The current best performance and design data for the NERVA FX Hot-Bleed Engine, Model No. AJ30-5 are presented. The FX engine is for use in the Reactor-In-Flight-Test (RIFT). (auth)

10820 (AGC-2280) CONCEPTUAL DESIGN FOR COOLED BOTTOM SUPPORT PLATE FOR NRX-B REACTOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 56p. Dep. NTIS $6.00.

Declassified 7 Sep 1973.

A basic objective of the NERVA program is the demonstration of a nuclear-powered rocket engine in flight at the earliest possible date. The reactor design of this engine is to be based on Kiwi-B experience, converted as required to adapt it for flight. A basic ground rule of the program limits the commitments for NERVA hardware until the Kiwi-B design is test fired while utilizing LH_2 propellants. In order to determine those further steps which might reasonably be undertaken to assure adequate reactor test information, and to explore the possibility of acheiving prototype reactor tests at the earliest possible date, the NERVA Operations Office conducted a conceptual study concerned with these main areas: reactor configuration (B-1 or B-4); core support configuration; and schedules for development, fabrication, and test. The study resulted in a recommendation that the Kiwi B-1 fuel element-module design be utilized in a bottom-support arrangement because this configuration: Meets the NERVA power density requirements; is essentially defined, from the standpoint of neutronics, as the result of LASL test experience; has existing fuel-element hardware that could be incorporated into a flight-type design in the shortest possible time with no additional testing required to define the neutronics of the system; and has a growth potential comparable with the balance of NERVA engine components. It was concluded that flight-type, core-support hardware could be designed, fabricated, tested, and delivered in sufficient quantity in time to allow a cooled-bottom supported flight version of the Kiwi B-1 reactor (identified in this report as the CBS-1 reactor), to be test fired within a year after authorization to proceed. It was further concluded that the power capability would be improved by the bottom support; and that a direct substitution of B-4 elements could be made in the B-1 module system, thus permitting a growth in concept to a power capability well in excess of 2000 MW. (auth)

10821 (AGC-2492) STANDARD NERVA ENGINE ANALYTICAL MODEL FOR RADIATION ANALYSIS. (Aerojet-General Corp., Azusa, Calif. (USA)). Feb 1963. 17p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

An analytical model of the NERVA engine for use in radiation analysis is described. It is based on the NRX-A core design with hot bleed and represents the engine design as of 11-15-63. (LTN)

10822 (AGC-2543) GENERATION II NERVA ENGINE SIMULATOR. Final Report. Goldman, M. (Aerojet-General Corp., Azusa, Calif. (USA)). 30 Jun 1963. 166p. Dep. NTIS $11.50.

Declassified 10 Sep 1973.

The Generation II Model I Engine Simulator Final Report presents complete engineering documentation of the NERVA engine cold-flow simulator program. The tests were conducted, using available prototype and necessary substitute hardware, to duplicate as closely as possible the thermal and hydraulic characteristics of a Heated-Bleed cycle NERVA engine. The primary purpose of the program was to obtain start transient information useful in establishing, by test and mathematical model, optimum start procedures for Heated-Bleed E-1 engine. (auth)

10823 (AGC-2683) KIWI B-2A REACTOR DESIGN REVIEW. Geer, L. A.; Shaffer, P.; Flagg, A. H.; Beveridge, J. H. (Aerojet-General Corp., Azusa, Calif. (USA)). 31 Jan 1964. 366p. Dep. NTIS $21.50.

Declassified 10 Sep 1973.

A design review of the Kiwi B-2 Reactor is presented, including drawing reviews and failure-mode evaluations, thermal analyses, strain gage tests of ATJ carbon, strain in supports, and vibration analyses. An appendix traces the development of the Kiwi Reactor concept. Conclusions are drawn and recommendations made. (auth)

10824 (LMSC-A-984555(VOL.1)(PH.3)) NUCLEAR SHUTTLE SYSTEMS DEFINITION STUDY. Phase III. Volume I. Executive Summary. Final Report. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA). Space Programs Div.). 1 May 1971. 60p. Dep. NTIS $6.00.

The principal objectives of this study were related to: Preliminary technical definition of the Reusable Nuclear Shuttle (RNS) based on a modular concept; program requirements for this RNS concept; mission and performance data; preliminary interface requirements between the RNS and other system elements in the current NASA plan; and specialized analytic studies in support of the RNS program. The technical definition of the RNS consisted of the appropriate system and subsystem selection, description, and integration into the overall vehicle. This effort was supported by the appropriate drawings, schematics, block diagrams, and descriptions required to define the RNS. The program requirements consisted of the operation, deployment plan and development requirements. The operational requirements were identified to the degree necessary to establish the design requirements for the RNS. The development requirements were identified to the degree necessary to identify supporting requirements, schedules, and funding plans. The mission and performance data for the RNS were based upon the use of the vehicle as a primary logistic carrier for lunar program support. Additional data for use of the RNS as a geosynchronous shuttle, planetary probe launch systems, and manned planetary mission propulsion system were also developed. The RNS, as a part of the overall NASA plan, will interact with various additional elements of the integrated plan and these interactions are identified and the preliminary interface requirements between the RNS and the affected elements developed. Specialized analytic studies in the area of RNS tank pressurization systems, captive test stand criteria support, and flight safety analysis were included. (auth)

10825 (LMSC-A-984555(Vol. 2)(Pt. B)) NUCLEAR SHUTTLE SYSTEMS DEFINITION STUDY. Phase III. Volume II. Concept and Feasibility Analysis. Part B. Baseline System Definition. Final Report. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). 1 May 1971. 216p. Dep. NTIS $14.00.

The Reusable Nuclear Shuttle is a completely self-contained space transportation system propelled by the 75,000-pound thrust NERVA engine which uses hydrogen as propellant. The basic system is of modular design, with all modules launched to Earth orbit by the Space Shuttle. The modules are then assembled in Earth orbit into a Reusable Nuclear Shuttle (RNS). The baseline vehicle consists of a space frame module, six propellant modules, and one propulsion module. The total propellant load of the vehicle is 269,427 pounds of hydrogen. All of the structural systems, propulsion systems, and astrionics systems are defined. A synthesis of the completely defined modules and RNS is made which includes inboard profiles of the modules and vehicle, a schematic of the vehicle, and the mass properties of the vehicle. It also includes the thermal and radiation environment of the RNS. A drawing tree was developed to provide traceability to the major drawings of the RNS. In a similar manner, a schematic tree was developed. The RNS interfaces are defined. (auth)

10826 (LMSC-A-989044(PH.3)) NUCLEAR SHUTTLE SYSTEM DEFINITION STUDY. Phase III. Final Performance Review. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). 14 Apr 1971. 190p. Dep. NTIS $12.50.

The Reusable Nuclear Shuttle (RNS) definition was concentrated solely on a modular stage design. The basis for this design and the general operating approach had been developed in Phase II and formed the baseline system for Phase III. In the modular concept, all elements of the RNS are assembled in orbit from hardware delivered by a sequence of Space Shuttle launches. In this concept the Space Shuttle also provides all support and logistics services to the RNS. The concept has the additional advantage of extending the level of maintainability of the RNS, since any module can be replaced and returned to Earth for maintenance and refurbishment. Many design features and planned operations are reviewed. (auth)

10827 (MDC-G-2134(Vol. 1)(Ph. 3)) NUCLEAR SHUTTLE SYSTEM DEFINITION STUDY. Phase III. Final Report. Volume I. Executive Summary. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). May 1971. 50p. Dep. NTIS $5.50.

The leading program in future NASA system development is the space shuttle, which promises significant reductions in transportation cost to earth orbit through the introduction of reusability. The performance capability of the nuclear engine will provide the next major step in the evolution of space transportation systems. The reusable Nuclear Stage (RNS) extends the economics of reusability to missions beyond earth orbit. The RNS, like the space shuttle, is conceived as a multipurpose transportation system. Initially, it would serve as an interorbital shuttle (primarily lunar and geosynchronous orbits) and provide injection for un-

manned probes. In this role and operating in conjunction with the space shuttle, the RNS would reduce transportation costs to lunar orbit by an order of magnitude below Saturn Apollo. The high performance of the RNS would be important for economical performance of ambitious unmanned missions such as a Mars surface sample return probe or delivering large space stations to lunar or geosynchronous orbit. In an evolutionary space program, the RNS would provide unmatched capability for performing manned planetary missions at transportation costs comparable to the Saturn Apollo lunar mission. The Phase III Nuclear Shuttle Definition Study is described. (auth)

10828 (MDC-G-2134(Vol.2)(Pt.A)(Bk.1)) NUCLEAR SHUTTLE SYSTEM DEFINITION STUDY. Phase III. Final Report. Volume II. Concept and Feasibility Analysis. Part A. Class 1 Hybrid RNS. Book 1. System Analysis and Operations. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). May 1971. 380p. Dep. NTIS $22.00.

The technical analyses, tradeoffs, and descriptions of the design and operations of a Reusable Nuclear Shuttle (RNS) are presented. Two RNS concepts were selected for further evaluation during Phase III: (1) Class 1 Hybrid, a 33-ft-diameter configuration launched to orbit by a Saturn INT-21, but with NERVA launched to orbit separately as a propulsion module by the space shuttle; and (2) Class 3, a modular configuration assembled in orbit from modules launched by the space shuttle. The distinctions between these concepts were maintained within the context of parallel evaluations. The design and operations activities on the Class 1 Hybrid RNS are reported herein. Documentation of the results of these activities has been organized in a manner which permits the reader to focus on each aspect of the system definition as an entity: The final baseline design; the RNS mission applications and the reference lunar shuttle mission; the complete set of RNS operations from prelaunch through the reference mission, establishing the basis for RNS design requirements and interfaces with other planned systems; the design analyses performed in response to these; and the resulting RNS design as an integrated system. The RNS modules and subsystems and the recommended NERVA/stage interface are also described. (auth)

10829 (MDC-G-2134(Vol.2)(Pt.A)(Bk.2)) NUCLEAR SHUTTLE SYSTEM DEFINITION STUDY. Phase III. Final Report. Volume II. Concept and Feasibility Analysis. Part A. Class 1 Hybrid RNS. Book 2. System Definition. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). May 1971. 247p. Dep. NTIS $15.50.

The Reusable Nuclear Shuttle (RNS) Class 1 Hybrid (1-H) concept is described. The vehicle is based in low earth orbit (260-nmi altitude, 31.5-degree inclination) and provides transportation in a shuttle mode to more distant destinations. Its design mission is a round trip to a 60-nmi lunar polar orbit. It is maintained and replenished in earth orbit by the space shuttle. It consists of three distinct modules which can be assembled and disassembled in space. The aft module, called the propulsion module, contains NERVA and a small run tank of propellant. The propellant module provides the main propellant tank and minimal propellant management subsystems. At the forward end of the stage is a command and control module (CCM) which contains most of the functional equipment and all of the expendables except for main stage LH_2. This module is replaced between missions in earth orbit, thereby effecting a replenishment of expendables and all scheduled maintenance. Both the propulsion module and the CCM are designed to be transported to earth orbit within the cargo bay of the space shuttle. This facilitates replacement of the CCM, as noted, and the NERVA, as might be required because of failure or to extend the lifetime of the RNS beyond that of the engine. The RNS is resupplied with LH_2 in earth orbit by the space shuttle between missions. The total propellant capacity of the stage is 300,000 lb of LH_2, of which 10,850 lb of LH_2 is contained in the run tank on the propulsion module. The modules are contained within a 10-degree half-angle cone subtended by the NERVA reactor which resulted from a combined optimization of structural and shield weights during Phase II. The run tank diameter on the propulsion module is constrained to 160 in. to limit the radiation shield weight, but still provide adequate volume to allow nearly autonomous operation, independent of resupply by the propellant module. The RNS design and operations concept minimizes orbital support requirements. The space shuttle is utilized to deliver replacement modules and to resupply propellant. No permanent, manned, orbital facilities are required for maintenance or propellant resupply. (auth)

10830 (MDC-G-2134(Vol.2)(Pt.B)(Bk.1)) NUCLEAR SHUTTLE SYSTEM DEFINITION STUDY. Phase III. Final Report. Volume II. Concept and Feasibility Analysis. Part B. Class 3 RNS. Book 1. System Analysis and Operations. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). May 1971. 394p. Dep. NTIS $22.75.

The technical analyses, tradeoffs, and descriptions of the design and operations of a Reusable Nuclear Shuttle (RNS) are described. The Class 3 RNS is a modular configuration assembled in orbit from modules launched by the space shuttle. The design and operations activities on the Class 3 RNS are reported herein. Documentation of these activities has been organized in a manner which permits the reader to focus on each aspect of the system definition as an entity: The final baseline design; the RNS mission applications and the reference lunar shuttle mission; the complete set of RNS operations from prelaunch through the reference mission, establishing the basis for RNS design requirements and interfaces with other planned systems; and the design analyses performed in response to these. (auth)

10831 (MDC-G-2134(Vol.2)(Pt.B)(Bk.2)) NUCLEAR SHUTTLE SYSTEM DEFINITION STUDY. Phase III. Final Report. Volume II. Concept and Feasibility Analysis. Part B. Class 3 RNS. Book 2. System Definition. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). May 1971. 268p. Dep. NTIS $16.50.

The reusable nuclear stage (RNS) Class 3 concept is described. The vehicle is based in low earth orbit (260-nmi altitude, 31.5 degree inclination) and provides transportation in a shuttle mode to more distant destinations. Its design mission is a round trip to 60-nmi lunar polar orbit. It is launched, maintained, and replenished in earth orbit by the space shuttle. It consists of three distinct types of modules designed for launch to orbit inside the 15-ft diameter by 60-ft cargo bay of the space shuttle, and which can be assembled and disassembled in space. The propulsion module contains NERVA and a small run tank of propellant. This facilitates replacement of NERVA, as might be required because of failure or to extend the lifetime of the RNS beyond that of the engine. Primary propellant is contained in multiple tanks designated as propellant modules. These contain minimal propellant management subsystems. At the forward end of the stage is a command and control module (CCM) which contains most of the functional equipment and all of the expendables except main stage LH_2. This module is replaced between missions in earth orbit, thereby effecting a replenishment of expendables and all scheduled maintenance. The main feed system providing communication from any propellant module to the run tank on the propulsion module is shown. The RNS is resupplied with LH_2 in earth orbit by the space shuttle between missions. The vehicle configuration was selected to optimize the combined effects of biological shield weight, which favors maximum vehicle length; maximum stability and controllability, which favors minimum length; and minimum assembly operations from the fewest outboard modules. The baseline configuration shown employs four tandem propellant modules which, in conjunction with the small solid angle subtended by the run tank on the propulsion module, precludes the requirement for any biological shield. A fully adequate margin of safety is maintained for vehicle stability and controllability. The RNS design and operations concept minimizes orbital support requirements. The space shuttle is utilized to deliver replacement modules and to resupply propellant. A space tug is utilized to support assembly and replacement of modules and to safely dispose of expended propulsion modules. No permanent, manned, orbital facilities are required for maintenance or propellant resupply. (auth)

10832 (MDC-G-2134(Vol.3)(Pt.A)(Ph.3)) NUCLEAR SHUTTLE SYSTEM DEFINITION STUDY. Phase III. Final Report. Volume III. Program Support Requirements. Part A. Class 1 Hybrid RNS. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). May 1971. 264p. Dep. NTIS $16.25.

The program support requirements for the Class 1 Hybrid Reusable Nuclear Shuttle (RNS) are outlined. The definition and evaluation of all candidate component, subsystem, and system tests is contained in Section 2.2, within the categories of research and technology testing, development, qualification, acceptance, and reliability testing. Test hardware, ground support equipment, and facilities required to support the test program are defined. Manufacturing requirements include the candidate manufacturing and assembly techniques for each of the RNS modules. Various candidate location combinations were considered for the detail fabrication and final assembly operations as well as special trade studies which were performed on manufacturing methods. The results of the comparative evaluation formed the basis for a recommended manufacturing approach, which is documented in the form of a preliminary manufacturing plan. Results of the facilities definition effort are described with the facilities requirements categorized as test, manufacturing, and launch. A facilities utilization study was also performed

to assess the compatibility of currently available government and contractor facilities with the support facility requirements defined for the RNS, and the results are summarized. Estimates of the costs and schedules associated with the development of the required facilities are presented. The program definition effort is documented with the program assumptions and guidelines, including NERVA program characteristics, critical program milestones, and interfacing system elements delineated. An integrated program plan in the form of a master phasing schedule, program schedules and milestones, an operations plan, and a discussion of integrated support requirements is presented. (auth)

10833 (MDC-G-2134(Vol.7)(Ph.3)) NUCLEAR SHUTTLE SYSTEM DEFINITION STUDY. Phase III. Final Report. Volume VII. RNS Project Requirements. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). May 1971. 246p. Dep. NTIS $15.50.

The RNS Project Requirements Document contains all working data from functional analysis and operations analysis activities conducted during the RNS Phase III study and other programmatic information affecting the nuclear shuttle. (auth)

10834 (NJD-8) NRX/EST FINAL REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1966. 208p. Dep. NTIS $13.50.

Declassified 29 Aug 1973.

The significant objectives and major milestones achieved during the NRX/EST test series were demonstrations of: The feasibility of the hot-bleed-cycle nuclear engine system for transient and steady-state operation; the capability of the NRX-A reactor to operate at or near rated conditions for a cumulative period of approximately 30 min; the suitability of control-system concepts and stability of the engine system for transient and steady-state conditions over a broad area of the engine operating map; the multiple-restart capability of the engine system with various control modes by being started eight times to an intermediate power level and three times to rated power; and the capability of the engine system to accomplish bootstrap startup at a chamber-temperature ramp at or above 100°R/sec. In general, performance of the engine system was in accordance with pretest predictions. Engine parameters, such as temperatures, temperature distributions, pressures, pressure drops, flow rates, nuclear power, and engine system performance, were reproducible from one test of the series to another. Fuel element corrosion was greater than predicted and some damage was sustained by other core components. (auth)

10835 (NP-20383) PROSPECTS FOR A NUCLEAR POWERED MERCHANT SHIP PROGRAM. Program Report: Volume 1, Number 10. Brown, G. E. Jr. (Atomic Industrial Forum, Inc., New York (USA)). Apr 1974. 31p. AIF $20.00; $10.00 members.

Highlights are presented of a seminar on the prospects for nuclear merchant ship development. There appeared to be a consensus among the seminar participants on the following points: (1) It is timely for the U. S. to move forward with a second generation of nuclear powered merchant ships. It is important to regain the technological leadership in this sector to help lessen U. S. dependence on foreign oil sources and improve the competitive position of the U. S. merchant fleet in world trade. (2) There is need for a high level commitment by the Administration to further these objectives and to provide a sound basis for the substantial industrial investment that will be required. The Administration's present posture on the nuclear merchant ship program appears ambiguous and needs clarification. (3) Actual operating experience with second generation demonstration vessels is essential to provide the data necessary to confirm economic projections. Such data are a necessary element in orderly planning for full commercial utilization. Government-industry differences on what constitutes "economic" operation, and at what stage, must be resolved if the program is to move forward in a timely manner. (4) Regulatory processing of initial nuclear merchant ship applications will be a long, hard road with major uncertainties on cost and timing. Ship operators must become better acquainted with the complexities of the AEC reactor licensing system. Stimulus will be needed from the private sector if the government's regulatory machinery is to be ready to process license applications in a timely manner. (5) The insurance industry should be encouraged to move forward in establishing appropriate financial protection arrangements for nuclear merchant ships and to set rates for such protection. Ship operators should be alerted to current legislative consideration of the Price-Anderson Indemnity Act, which is up for renewal in 1977, and more particularly to the need for its application to nuclear merchant ships, not presently included under the Act. Problems of international liability, as dealt with in the draft Brussels Treaty, must also be resolved. (6) It will take concerted action by industry to help resolve these problems and to ensure that the nuclear merchant ship program moves forward into commercial utilization on a sound and timely basis. (auth)

10836 (NTO-I-0083) NRX-A5 TEST SERIES, SUPPORT OPERATIONAL REQUIREMENTS DOCUMENT. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 12 May 1966. 77p. Dep. NTIS $7.00.

Support operational requirements for the NRX-A5 Test Series are provided as a single source reference for much of the redundant material that would otherwise appear in the individual Experimental Plans. The requirements are listed for: Operational and Support Teams, Test Assembly and Facility Limits, Test Assembly and Facility Instrumentation and Data, Communications Nets, and Area Control. (auth)

10837 (NTO-R-0093) NRX-A5 CHEMICAL AND RADIOCHEMICAL MEASUREMENTS REPORT. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 30 Sep 1966. 29p. Dep. NTIS $4.50.

Declassified 10 Sep 1973.

The techniques and results of chemical and radiochemical measurements performed on the NRX-A5 core are described. Information is presented on total weight lost; axial variations in uranium, niobium, and carbon concentrations; radial and axial fission distributions; total fissions produced; and the correlation between niobium, fuel, and total weight losses. (auth)

10838 (RN-S-0024) NERVA NOZZLE CASTING PROGRAM. (Aerojet-General Corp., Azusa, Calif. (USA)). Jan 1964. 36p. Dep. NTIS $5.00.

Declassified 7 Sep 1973.

The fabrication problem with the cast aluminum nozzle jacket was under constant investigation during Contract Year 1963. The brittle failure of the first Kiwi nozzle resulted in an intensive casting development effort and has yielded an increase in the elongation of the metal in the T-6 heat-treated condition from 2.0% or less to a minimum of 6.0%. Although the structural integrity of the design was not fully demonstrated, there is every indication that the casting techniques developed will, with further work, yield the required soundness and mechanical properties. (auth)

10839 (RN-S-0026(Vol.3)) NERVA PROGRAM DESIGN REVIEW PRESENTATION TO SNPO ON 13-15 NOVEMBER 1963. Volume III. (Aerojet-General Corp., Azusa, Calif. (USA)). 30 Jan 1964. 241p. Dep. NTIS $15.25.

Declassified 7 Sep 1973.

The methods for improving reliability and quality assurance in fabrication are stressed in this review. The design and development of the pneumatic system V and its components are described. Also flight safety considerations and radiation effects tests are outlined. (LTN)

10840 (RN-S-0178) COMPARISON OF WANL AND LASL FUEL ELEMENT HYDROGEN CORROSION TESTING. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1964. 19p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

The major differences between WANL and LASL hydrogen corrosion test facilities and operating procedures that make direct comparison of temperature profiles and test results very difficult are described. The most significant differences are: Hydrogen flow rate, internal power generation, heated length of test element, length of element in the hot end chuck, and use of orifices. (auth)

10841 (RN-S-0179) PRE-IRRADIATION ANALYSIS OF TUNGSTEN-RHENIUM THERMOCOUPLES. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1964. 38p. Dep. NTIS $5.00.

Declassified 10 Sep 1973.

Tungsten-rhenium thermocouples were analyzed for their expected performance in a radiation field. All components of the thermocouples are inorganic, and their limitations are based on a long-term degradation. The degradation in full-power, full-duration NERVA firings is negligible. It was found that the largest temperature discrepancy will be caused by radiant energy dissipation to the cryogenic surface which the thermocouple penetrates. The discrepancy will be 54°F at full power, and should be regarded as a correction to be applied to read-out values. (auth)

10842 (RN-S-0333) X-E PERFORMANCE ANALYSIS STATUS REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1966. 102p. Dep. NTIS $8.25.

Declassified 11 Sep 1973.

The current status of systems analysis performed in support of the X-Engine is documented. Pretest predictions prepared

for XECF and preliminary analyses prepared to study a feasible method of normal pulse cooldown are described. Methods by which the Systems Analysis Department has continued to update state operation are also described. (auth)

10843 (RN-S-0368) PHASE I-A OF THE COUNTERMEASURES RADIATION EFFECTS PROGRAM. Final Report. Voreck, W. E.; Downs, M. E.; Lindberg, E. I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1967. 152p. Dep. NTIS $10.75.

Declassified 12 Sep 1973.

The Countermeasures Radiation Effects Program involved small-scale tests on 1.8 gm samples of explosives and propellants loaded into capsules small enough to be irradiated in the GE Test Reactor (GETR), Z-Trail Cable Facility. The preliminary testing of radiation-stable detonators and evaluation of three new high-temperature-stable explosives is reported. The explosive tests performed were differential thermal analysis, thermogravimetric analysis, melting point, vacuum stability, weight loss, and gas release. In addition, irradiated detonators were test-fired and the plate dents were measured. Two important properties of pseudostable materials exposed to reactor radiation are radiation stability and temperature stability. These properties are summarized for each material. The most radiation-stable primary explosive tested was KDNBF. The most radiation-stable booster explosive is ABH, and the most temperature-stable is NONA. The most-radiation-stable main-charge explosives were TATB and TACOT. TATB has more energy output, about the same as that of Composition B, and TACOT has better temperature stability. The most-radiation-stable material tested was black powder, which is an inorganic mixture of sulfur, charcoal, and potassium nitrate. However, when the sulfur melts at 120°C, performance becomes erratic. Standard gun propellants containing nitrocellulose and nitroglycerine were very unstable under both radiation and heat exposure. The composite propellants containing $KClO_4$ were limited by relatively poor radiation stability, although they had high temperature stability. The most-radiation-stable propellant tested combined one of the best explosives (DATB) with a binder. A total of nine capsules of detonators were irradiated, three for each type of explosive. (auth)

10844 (RN-S-0493) XE-PRIME MALFUNCTION ANALYSIS. Fenech, E. J.; Guide, R. J.; Pfremmer, R. D. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Feb 1969. 241p. Dep. NTIS $15.25.

Declassified 12 Sep 1973.

A malfunction analysis of the XE-Prime engine system has been conducted to evaluate the adequacy of the engine safety system. The studies were made with the engine initially operating under both steady-state and transient conditions. The malfunction study demonstrated that the engine safety system adequately protects the engine system from most of the component failures evaluated. The results, however, indicate that some malfunctions will adversely affect the entire system and corrective action is required either to prevent these malfunctions or to limit their effect on the engine system. A summary of the effect of each malfunction analyzed is presented. (auth)

10845 (RN-S-0510) XE-PRIME ENGINE FINAL REPORT. Supplement to Volumes II and III. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 33p. Dep. NTIS $4.75.

Declassified 12 Sep 1973.

The results of a past test examination of the XE-PRIME reactor core components and fuel elements are presented. Damage to components was not serious. Four fuel elements had fractured in the half of the reactor core examined in detail and some corrosion was evident. The observed reactivity change in the reactor during testing is explainable in terms of the observed fuel element weight loss. (LTN)

10846 (RN-TM-0311) METALLURGICAL INVESTIGATION OF NERVA MK III MOD 4 TURBINE ROTORS. Dessau, P.; Emmons, W. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1966. 46p. Dep. NTIS $5.50.

Declassified 11 Sep 1973.

Metallurgical investigations were conducted on similar fatigue-type cracks in two rotors of differing materials used in first-stage turbine discs of Mark III Mod 4 NERVA Turbopumps. One crack progressed to catastrophic failure; the other was detected during post-test inspection. The disc materials were D979 and A 286 respectively. The materials of each rotor were tested. Mechanical properties tests performed on each rotor included tension at room and cryogenic temperatures, and fracture toughness by pre-cracked Charpy-V impact and slow-bend from −320 to +400°F. Fatigue tests at room temperature were also conducted to evaluate the effects of machined, polished, hydrohoned and shot-peened surface finishes. Forging variables are discussed together with recommendations for an improved procurement specification. (auth)

10847 (SD-70-644(Phase3)) NUCLEAR SHUTTLE SYSTEM DEFINITION STUDY. Phase III. Second Interim Review. Littman, T. M. (North American Rockwell Corp., Downey, Calif. (USA). Space Div.). 16 Dec 1970. 190p. Dep. NTIS $12.50.

Phase III of the Reusable Nuclear Shuttle (RNS) study is being conducted basically in three steps with reduction in number of options and increase in analytical depth with each succeeding step. Of paramount importance was the investigation of mission operations and requirements including identification of alternatives and evaluation of their attractiveness in order to establish RNS design criteria and constraints. Orbital operations received primary attention covering all steps required to support the RNS from rendezvous and docking to fueling and maintenance. System definition studies were concerned with screening the new RNS configurations identified for Phase III by means of tradeoffs considering such factors as facility constraints, weight, thermal impact, performance, radiation environment, and boost loads. Through this process, the range of attractive design alternatives was reduced and a new baseline identified as a standard for comparing conical tank bottom concepts. The preliminary design data were essential to support the operations studies and identify differences in design requirements and constraints. However, the major effort was on design trades, at both the system and subsystem level. Integrated design studies were conducted to develop the most attractive overall concept considering operational, performance, and cost factors as well as design considerations. Particularly noteworthy are the nuclear radiation and thermal/hydrodynamic studies. A reliability assessment was initiated and is continuing. Cost trades were performed identifying areas where substantial improvements in cost effectivity may be achieved. Alternate engine-stage interfaces were synthesized for the candidate RNS configurations. (auth)

10848 (SD-71-466-1(VOL.1)(PH.3)) NUCLEAR FLIGHT SYSTEM DEFINITION STUDY. Phase III. Final Report. Volume I. Executive Summary. Garcia, D.; Jusak, A. R.; Antypas, W. G. (North American Rockwell Corp., Downey, Calif. (USA). Space Div.). Apr 1971. 70p. Dep. NTIS $6.50.

The basic goal of the study was to define Reusable Nuclear Shuttle (RNS) concepts to provide low-cost space transportation in the early 1980's. Progressive growth in a cost-effective manner to meet later manned planetary applications represented an important adjunct requirement. A high degree of reusability combined with maximum practical dependence on commonality is essential if RNS costs are to be kept low. The major space program elements and concepts which will contribute to the attainment of this goal are described, especially conceptual design, missions and uses, cost, and the relation to other NASA programs. This is essentially a feasibility and systems analysis. (auth)

10849 (SD-71-466-3(Vol.2)(Ph.3)) NUCLEAR FLIGHT SYSTEM DEFINITION STUDY. Phase III. Final Report. Volume II. Concept and Feasibility Analysis. Part B. Baseline System Definition. Garcia, D. (North American Rockwell Corp., Downey, Calif. (USA). Space Div.). Apr 1971. 187p. Dep. NTIS $12.50.

The detail design of the baseline Reusable Nuclear Shuttle (RNS) configuration is presented, including engineering drawings, subsystems, schematics, components, mass properties, and interface requirements. Also presented is a brief description of each of the selected subsystems and the Design Criteria and Constraints. The recommended RNS baseline is a single tank conical aft bulkhead configuration with an 8-degree half cone angle and a 25-inch cap radius, launched inverted without the NERVA engine on an INT-21 booster. A nose cone shroud is used over the conical aft bulkhead during the boost phase. The NERVA engine is delivered to orbit via the Space Shuttle and mated to the stage in earth orbit to complete the operational vehicle. The overall dimensions of the vehicle for 300,000 pounds of LH_2 with 5 percent ullage volume are given. The stage overall length including the engine is 194 feet. The high fineness ratio conical bulkhead enhances radiation attenuation by combining the benefits of increased separation distance of payload from NERVA and of reduced neutron/gamma energy transmitted into the tank due to the smaller view angle. The configuration meets the radiation dose criterion of 10 REM at the tank top with an external shield weight of 4050 pounds. (auth)

10850 (SD-71-466-4(Ph.3)(Vol.2)(Pt.C)) NUCLEAR FLIGHT SYSTEM DEFINITION STUDY. Phase III Final Report. Volume II. Concept and Feasibility Analysis. Part C. System Engineering Documentation. Jusak, A. R. (North American Rockwell Corp., Downey, Calif. (USA). Space Div.). Apr 1971. 245p. Dep. NTIS $15.25.

The Reusable Nuclear Shuttle (RNS) is a major, new, low-cost transportation system proposed in a NASA Integrated Space Pro-

gram Plan. The RNS is comprised of a propellant tank with a tank capacity for 300,000 pounds of LH_2, a 75,000-pound thrust nuclear engine, and associated subsystems to permit autonomous mission operation. The primary mission is the delivery of men and material between lunar/geosynchronous and earth orbit. The second mission is the injection of unmanned payloads on planetary intercept trajectories after which the RNS returns to its earth operational orbit. Ultimately, through evolutionary growth, the RNS will provide the propulsive requirements for manned planetary missions. Conceptual designs are subjected to detailed feasibility and systems analysis studies in the performance of possible missions, including a detailed chronology of the operations required. Requirement allocation sheets for these operations are detailed with references to their source. Time schedules for these operations are plotted. Finally, a few changes in the NERVA engine are suggested. (auth)

10851 (SD-71-481-2(Ph. 3)) NUCLEAR SHUTTLE SYSTEM DEFINITION STUDY. Phase III. Final Review. Littman, T. M. (North American Rockwell Corp., Downey, Calif. (USA). Space Div.). 15 Apr 1971. 210p. Dep. NTIS $13.50.

The objectives of the Phase III study of the Reusable Nuclear Shuttle (RNS) are summarized. The benefits of reusability, commonality, design and operational simplicity, and autonomy were exploited to the maximum practical extent to achieve the study goal. Repetitive, realistic lunar shuttle cycles were established — employing precision flight mechanics techniques — with payload delivery capabilities equal to or exceeding the requirements identified in other studies. Similarly, a substantial capability was defined for other shuttle missions as well as injection flights (particularly in conjunction with an expandable tug) covering both unmanned explorers and manned Mars payloads. A stage concept (high fineness ratio single tank) and launch mode (inverted tank on INT-21 with NERVA delivered by space shuttle) have been defined which appears about optimum within the study constraints. As a result of the investigation to date, a considerable amount is known about anticipated ground, orbital, and flight operations. Furthermore, although the RNS must operate in the unique and hazardous nuclear radiation environment associated with this superior power source, routine and safe operations — including maintenance — appear possible by proper design and planning of operating procedures. Furthermore, although numerous uncertainties exist and will persist until the RNS program reaches a greater state of maturity, no significant problem areas have been uncovered which might threaten its technical feasibility or substantially affect its economic attractiveness. The study also identified a number of potentialities for further cost avoidance or reduction. Some of these are largely beyond the control of the RNS program (such as space shuttle logistics delivery cost). Others probably can be implemented by changes in design, operations, or program activities. Typically, these include higher NERVA I_{sp} (even at the expense of reduced life), use of a fully or partially reusable booster for the RNS tank, alternate mission flight modes, and other items. (auth)

10852 (TID/SNA-1699) DUAL MODE NERVA APPLICATIONS STUDY. Letter Progress and Status Report No. 2. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 21 Jan 1972. 40p. Dep. NTIS $5.00.

Methods of saving propellant (1) by using decay heat as possible and using less propellant for cooling and (2) saving propellant by use of lower tank pressure, boiloff conservation and saving in engine chilldown could make possible considerable saving of propellant weight or increased payload. Other efforts involve calculation of velocity requirements for several space missions. (auth)

10853 (TID/SNA-1717) VIEWGRAPH MASTER VELLUM FILE. Book 1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 386p. Dep. NTIS $22.50.

10854 (TID/SNA-1721) NOZZLE, SEMI-ANNUAL STATUS REVIEW. Shurley, L. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1971. 21p. Dep. NTIS $4.25.

10855 (TID/SNA-1722) NOZZLE EXTENSION, SEMI-ANNUAL STATUS REVIEW. Shurley, L. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1971. 18p. Dep. NTIS $4.00.

10856 (TID/SNA-1723) NOZZLE, EXTENSION, PRESSURE VESSEL. Semi-Annual Status Review. Shurley, L. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1971. 11p. Dep. NTIS $4.00.

10857 (TID/SNA-1727) NOZZLE ASSEMBLY TRADE STUDY (TS 301). Decisions and Justifications. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 228p. Dep. NTIS $14.50.

A trade study on nozzles is reported, dealing with such features as areal ratio, skirt extensions, losses (due to exit losses, boundary layer losses, kinetic losses, vibration, contour imperfection, etc.). (LTN)

10858 (TID/SNA-1872) RELIABILITY AND FLIGHT SAFETY MEETING, TECHNICAL DISCUSSION. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 21 Apr 1970. 345p. Dep. NTIS $20.25.

The methods by which reliability and safety were to be incorporated into the NERVA program are illustrated with particular studies. In general they involved a conceptual design review, the establishment of design requirements base lines, a preliminary design review and finally a demonstration design review. Also involved were trade studies with respect to weight, cost, performance, reliability and safety and various failure mode analyses, fault tree analysis, trend data studies, etc. (LTN)

10859 (TID/SNA-2014) NERVA RELIABILITY AND SAFETY ANALYSIS METHODS. Volume IIIa. Reliability Statistical Methods. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1972. 172p. Dep. NTIS $11.75.

10860 (TID/SNA-2015) NERVA RELIABILITY AND SAFETY ANALYSIS METHODS. Volume IIIb. Statistical Distributions and Tables. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1972. 196p. Dep. NTIS $13.00.

In the design for reliability approach, the use of statistical methods is given heavy emphasis. As a result, the knowledge and application of these methods forms a basic portion of the design technology. Of particular concern are physical phenomena and the statistical distributions used to represent them. The purpose of this reliability manual is to provide a basic understanding of what statistical distributions are and their underlying concepts, how they are characterized, how they occur typically and how they are recognized, how their parameters are estimated, and how and when they are used. Tables appropriate to most of the distributions are presented in conjunction with how the tables are used. In most cases, an example of the application of each distribution is presented using problems pertinent to NERVA. (auth)

10861 (TID/SNA-2016) NERVA RELIABILITY AND SAFETY ANALYSIS METHODS. Volume IV. Reliability Testing, Trend Data and Failure Analysis. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1972. 109p. Dep. NTIS $8.50.

Guidelines are established for reliability review of test plans and/or specifications for materials, major components, subsystems, and systems during development, prequalification, qualification, and flight testing. The methodology of planning tests and the statistical methods of analysis are given in some detail for fatigue testing, determination of material properties, failure analysis and response, identification and monitoring of trend, wear, or degradation of critical characteristics. Terms are defined, procedures established and responsibilities assigned with the aim of attaining design and reliability goals effectively and economically. (LTN)

10862 (TID/SNA-2017) NERVA RELIABILITY AND SAFETY ANALYSIS METHODS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1972. 125p. Dep. NTIS $9.25.

10863 (TID/SNA-2111) NRX/EST: THE FIRST EXPERIMENTAL NUCLEAR ROCKET ENGINE. Evleth, R. V.; Buden, D. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1966. 16p. Dep. NTIS $4.00.

The NRX/EST engine experimentally verified the basic design of the hot bleed nuclear rocket system. Unique features of the engine include a horizontally mounted turbopump and radiation shielding for components that had not, as yet, demonstrated their ability to function in a radiation environment. Liquid hydrogen from the facility dewars is pumped by means of the engine turbopump. During operation, on completion of the turbopump chilldown, the pump discharge valve is opened and the liquid hydrogen flows in series through the nozzle jacket, the reactor reflector and into the forward closure where it is dispersed through the reactor core. The hydrogen is heated as it passes through the reactor core and is then expelled through the nozzle, thereby providing thrust. A portion of the hot gas is diverted through a nozzle bleed port and is conducted to the turbine that drives the pump. This hot gas is conditioned to the proper turbine temperature by mixing it with cold diluent which is tapped from the pressure vessel forward closure. No external energy source is required to start the engine. Successful engine startups were demonstrated with ambient reactor conditions typical of ground operation and cold reflector conditions typical of a restart in

space. The ability to start with both high and low dewar pressures was demonstrated. In addition, a fixed reactor control drum start was made that offered possibilities of future design simplification. These starts closely followed test predictions in their performance. (auth)

10864 (TID/SNA-2278) HOT BLEED CYCLE, 75K NERVA ENGINE SYSTEM ANALYSIS. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 246p. Dep. NTIS $15.50.

Declassified 11 Sep 1973.

NERVA component performance information required for systems analysis is documented (particularly that information reduced for input into the D31201 NERVA engine computer model). A sample record of input used in this computer program is provided. This book will also provide a record of engine changes so all changes leading to the current engine design can be traced. (auth)

10865 (TID/SNA-2291) NRX-A PRESSURE VESSEL METALLIC SEALS, TEST SERIES I EVALUATION REPORT. Locke, J. N. (Aerojet-General Corp., Scaramento, Calif. (USA)). 29 Jan 1964. 76p. Dep. NTIS $7.00.

Declassified 10 Sep 1973.

Series I NERVA pressure vessel metallic seals test successfully demonstrated the integrity of pressure vessel closure S/N 002, which had undergone repairs at the vendor's facility. The test also evaluated three sets of one seal configuration designed to limit helium gas leakage to less than 10^{-2} standard cubic centimeters per second, per inch of diameter, at proof pressure of 645 psig. The quantity of leakage measured differed considerably from set to set because of variations in test conditions, seal groove cleanliness and seal to seal variation. The design requirement for leakage to be less than 10^{-2} standard cubic centimeters per second per inch of diameter should be re-evaluated: It is very difficult to maintain such small flows. (auth)

10866 (TID/SNA-3015) SYSTEM FAILURE-MODE EFFECT AND CRITICALITY ANALYSIS FOR THE NERVA ENGINE, INSTRUCTIONS FOR. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1 Jul 1970. 13p. Dep. NTIS $4.00.

The purpose of this procedure is to establish the criteria for Failure-Mode effect and Criticality Analysis (FMECA) and define responsibilities for its preparation and utilization in the design of the NERVA engine. It establishes a uniform means for preparing FMECA's by applying a systematic approach to failure identification at the component level and determining the system effect and criticality of the failure. The requirement for this procedure is set forth in Data Item R-101, NERVA Reliability Program Plan. (auth)

10867 (TID/SNA-3016) NERVA PROGRAM PROCEDURE. Single-Failure-Point Reporting, Analysis, Correction, and Closeout. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Oct 1970. 10p. Dep. NTIS $4.00.

One of the primary objectives of both the Reliability and Safety Programs as stated in their respective plans is to identify, eliminate if possible, and make known for Government approval or direction all single failure points which could result in inability of the engine to meet its normal-mode performance and service-life requirements. The purpose of this procedure is to define single failure points (SFP's) for the NERVA engine system, how they are identified, the analyses required for their evaluation, and the method for processing and documenting SFP's through and including final disposition. NERVA engine single failure point summaries will be used as a basis for hardware test planning and for mission contingency planning. Other relevent documents are listed and definitions, responsibilities and procedures are explained. (auth)

10868 (TID/SNA-3017) COMPONENT FAILURE-MODE ANALYSIS FOR THE NERVA ENGINE, INSTRUCTIONS FOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 26p. Dep. NTIS $4.50.

The purpose of this procedure is to establish the criteria for Component Failure-Mode Analysis (FMA) and define responsibilities for their preparation and utilization in the design of components for the NERVA engine. It establishes a uniform means for preparing FMAs by applying a coordinated systematic approach to failure identification at the part failure mechanism level and evaluation of its causes. The requirement for this procedure is set forth in Data Item R-101, NERVA Reliability Program Plan. Other relevent documents are listed. The policy is that failure mode analysis will be an integral part of the design process, assuring a systematic and detailed review of all the possible ways a component can fail to perform its function. Terms are defined and responsibilities identified. (auth)

10869 (TID/SNA-3018) SMALL NUCLEAR ENGINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 28 Apr 1966. 45p. Dep. NTIS $5.25.

Declassified 10 Sep 1973.

The conceptual design and anticipated performance of a small nuclear engine are discussed (7500-15000 lb thrust, hot-bleed). (LTN)

10870 (TID/SNM-48) REUSABLE NUCLEAR STAGE SYSTEM DEFINITION STUDY. Phase IV. Third Monthly Letter Progress and Status Report, January 1–January 31, 1972. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). 11 Feb 1972. 12p. Dep. NTIS $4.00.

A parametric sizing analysis was made for a stage using a small nuclear engine (14,000 lb thrust). Engine/stage interface problems were studied and recommendations made with respect to interface location and maintenance. Work continued on several Trade Studies. (LTN)

10871 (TID/SNM-49) ENGINEERING OPERATIONS TRIP REPORT: MDAC ENGINE/STAGE INTERFACE RECOMMENDATIONS. DaVolio, J. R. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 24 Jan 1972. 5p. Dep. NTIS $4.00.

10872 (TID/SNW-49) HIGH EXPANSION GRAPHITE FLOUR EXTRUSION. Test Specification IIG-a. Johnson, M. T.; Corrington, L. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1968. 9p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

10873 (TID/SNW-54) TRADE STUDY FOR NERVA FUEL ELEMENT DESIGN CONCEPTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1969. 534p. Dep. NTIS $29.75.

Declassified 10 Sep 1973.

A Trade Study of design concepts for the Fuel Elements, a component of the NERVA Nuclear Subsystem, NSS, is reported. The purpose was to evaluate and select the most logical and reasonable concept of this component for continued detail design and development consistent with the programmatic and technical requirements for the 10 hour, full flow cycle engine defined in the NERVA Program Requirement Document. Each concept was evaluated against the requirements and the tentative selection was based on an objective approach which identifies the concept having the maximum likelihood of meeting the functional, technical and programmatic requirements. The Standard Geometry, High Expansion Graphite Fuel Element and the Standard Geometry, Composite Fuel Element are selected and recommended for continued detail design and development. The major factors leading to this selection are described. (auth)

10874 (TID/SNW-61) TRADE STUDY FOR NERVA CLUSTER, STEM AND HOT END DESIGN CONCEPTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 356p. Dep. NTIS $21.00.

A Trade Study of design concepts and material alternates for the Cluster, Stem and Hot End Hardware of the NERVA Nuclear Subsystem (NSS) is presented. A previous trade study wherein 7 cluster hardware concepts were compared resulted in the selection of the Counterflow Tie Tubes with Pedestals Concept that serves as the basis for this trade study. The purpose of the present study was to evaluate and select the most logical and reasonable approach for the continued design and development. The evaluation and selection was based on the construction of a comparison matrix. The functional and technical requirements were identified by the Systems Engineering December 1969 draft issue of the component specification, EC 677558. The stem material alternates evaluated were Inconel 718, A-286, and Waspaloy. The hot end hardware design concepts evaluated were tungsten-standoff, tungsten-contacting, composite standoff with tungsten retainer, and composite standoff with composite retainer. Inconel 625 and 316 stainless steel were considered as liner tube materials. Each concept was evaluated against the requirements and the tentative selection was based on an objective approach which identified the concept having the maximum likelihood of meeting the functional, technical, and programmatic requirements. Inconel 718 was selected as the stem material and Inconel 625 as the liner tube material. Two hot end hardware alternates were selected for further design and development: tungsten-standoff (Alternate 2.1) and composite standoff with tungsten retainer (Alternate 2.3). The design used in the R-1 reactor will be selected in a subsequent trade study to be completed prior to NSS PDR. (auth)

10875 (TID/SNW-63) TRADE STUDY FOR NERVA CORE PERIPHERY DESIGN CONCEPTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 407p. Dep. NTIS $23.50.

Declassified 10 Sep 1973.

A Trade Study of design concepts for the Core Periphery, a component of the NERVA Nuclear Subsystem, NSS, is presented.

The purpose was to evaluate and select the most logical and reasonable approach for continued detail design and development of this component consistent with the programmatic and technical requirements for the 10-hour full flow cycle engine as defined in the NERVA Program Requirements Document. The evaluation and selection was based on the construction of a comparison matrix. Each alternate was evaluated against the requirements and the tentative selection was based on an objective approach which identifies the concept having the maximum likelihood of meeting the functional, technical, and programmatic requirements. (auth)

10876 (TID/SNW-64) TRADE STUDY FOR NERVA SUPPORT PLATE AND PLENA DESIGN CONCEPTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1969. 186p. Dep. NTIS $12.50.

Declassified 10 Sep 1973.

A Trade Study of design concepts for the Support Plate and Plena, a component of the NERVA Nuclear Subsystem, NSS, is presented. The purpose was to evaluate and select the most logical and reasonable approach for continued detail design and development of this component consistent with the programmatic and technical requirements for the 10 hour full flow cycle engine as defined in the NERVA Program Requirements Document. The evaluation and selection was based on the construction of a comparison matrix. Each alternate was evaluated against the requirements and the tentative selection was based on an objective approach which identifies the concept having the maximum likelihood of meeting the functional, technical and programmatic requirements. The Combined Support Plate and Plenum (3 Plena) is the concept selected and recommended for continued detail design and development. The major factors leading to this selection are described. (auth)

10877 (TID/SNW-84) SNSO HEADQUARTERS MEETING WITH LASL, Y-12 AND WANL, DECEMBER 8-9, 1971. Insulator and Fuel Materials. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Dec 1971. 129p. Dep. NTIS $9.50.

Declassified 11 Sep 1973.

At a meeting dedicated to thermal insulators and fuel elements, development work related to these items was discussed. Several papers dealt with methods of fabrication of zirconium carbide and similar compounds and the relation between thermal conductivity, mechanical properties and density in the product and the changes in these properties with temperature. Papers on fuel elements dealt with fabrication, coatings, strength, corrosion, thermal stresses, structural models (including failure mechanisms), creep, etc. (LTN)

10878 (TID/SNW-103) TEST CELL "C" FACILITY REQUIREMENTS DOCUMENT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1970. 65p. Dep. NTIS $6.25.

The integrated facility requirements for Test Cell "C" (TCC), NRDS, for the development and qualification testing of the Nuclear Subsystem (NSS) are specified. (auth)

10879 (TID/SNW-111) REFLECTOR-NOZZLE DESIGN TRADE STUDY. Trade Study No. 780. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 May 1970. 108p. Dep. NTIS $8.50.

Eight NERVA nozzle-to-reflector joint concepts have been evaluated. It is evident that the reference design shown, the NRX-A6, and the Phoebus 2A all have similar nozzle-to-reflector joints. The technology gained from the NRX-A6 and the Phoebus 2A is therefore applicable in the evaluation of the eight concepts being presented in this trade study. The results of various methods of evaluation are presented. (auth)

10880 (TID/SNW-116) RELIABILITY CONSIDERATIONS FOR FUEL ELEMENT TRADE STUDY NO. 769. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Jun 1970. 21p. Dep. NTIS $4.25.

The Reliability objectives in support of the fuel element trade study are: To generate a detailed listing of failure modes at the component level, to gain assurance that no subtle differences between the design alternates are overlooked, to generate an extensive listing of failure modes and effects at the system level, to gain assurance that no subtle differences in system effects arising in cores based on the different design alternates (and combinations of alternates for various core components) are overlooked; and to compare the design alternates with respect to the potential problems identified at the component and system levels, and thereby derive a quantitative Reliability order of preference for use in selection of the most desirable fuel type. The Reliability preference based on information available at this time rates the composite design best, with the hybrid design second and the High Void Composite design a close third, (all are externally coated). The uncoated designs are rejected because of unacceptably high surface corrosion, while the graphite designs are rejected because coating damage and/or structural damage would result in unacceptably high corrosion losses. (auth)

10881 (TID/SNW-121) THIRD MONTHLY REPORT OF WNCO FUEL ENGINEERING. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Dec 1970. 39p. Dep. NTIS $5.00.

Declassified 10 Sep 1973.

Batches of composite fuel elements were fabricated coated with zirconium carbide and corrosion tested. The results are given in extensive tables. (LTN)

10882 (WANL-PR(J)-004) NERVA NUCLEAR SUBSYSTEM, PHASE I. Progress Report, October 1-October 31, 1961. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Nov 1961. 34p. Dep. NTIS $4.75.

Declassified 10 Sep 1973.

Significant progress has been achieved in the technical and program control areas in accordance with the planned Phase I program. Summary PERT network charts for the Nuclear Subsystem Phase I Program were completed and the initial computer summary runs were made successfully. A functional schematic reactor control system diagram was established for the preliminary design. An analog program was developed to represent heat transfer and flow conditions in the reactor core during startup. The preliminary reactor environmental specification was revised and incorporated in the study of the reactor and shield design. Methods of fabricating and supporting the reactor shield were studied for a lithium hydride shield material. A single channel analysis of fluid flow and thermal conditions during a transient has been completed and the digital computer code is now operating. Design investigation was continued on the PHOEBUS concept to determine the requirements for adequate cooling of the support tube and structure. The maximum temperatures were found at or near the exit which makes the problem of cooling the support rod flange critical. Initial detailed process procedures and pertinent equipment specifications for the fuel element operation based on the LASL process were completed. Vibration and static tests of graphite test specimens were initiated to determine damping coefficients, dynamic strain measurement techniques and modules of elasticity. (auth)

10883 (WANL-PR(J)-024) NERVA NUCLEAR SUBSYSTEM. Progress Report, June 1, 1963-June 30, 1963. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Jul 1963. 97p. Dep. NTIS $8.00.

Declassified 10 Sep 1973.

Qualification tests of the NRX-A reactor shipping container have been completed. The test results indicate that the shipping container satisfies all specification requirements. Fabrication testing of the 9-inch B4 fuel element lengths suspended in the lateral support system (NRX-A1 Single Coil Springs) has been completed. A full scale plastic model of the NRX-B Cooled Support Plate has been completed. The braze development program related to the bottom plate design has been completed. Modifications to the building at the WANEF site, where the reactor critical experiments will be conducted, have been completed. The required assembly stands, fixtures, and tooling are available, and the reactor assembly laboratory has commenced operations. Final Test Specifications for the fuel material and fission product radiation tests to be conducted at GETR, TREAT and WREC during the remainder of CY 1963 have been issued. (auth)

10884 (WANL-PR(J)-025) NERVA NUCLEAR SUBSYSTEM. Progress Report, July 1-July 31, 1963. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Aug 1963. 111p. Dep. NTIS $8.75.

Declassified 10 Sep 1973.

In WANL-TME-418 it was shown that there is no positive assurance that all of the NRX-A core peripheral seals will seat if pressure drops are the only driving force. As a result of these analyses, a 30 degree angle, which will provide the necessary force to seat the seals, has been incorporated on the seal contact area and the lateral support plunger. Slotted seal segments will be incorporated in all reactors beginning with NRX-A1. The slots, which are located on the inside diameter of the lateral support seal segments, control the seal by-pass coolant flow necessary for pressure balancing and thermal gradient control. The design of a segmented plate which will retain poison wires during shipment was completed and drawings were released. Orificing and clustering for phase I vibration reactor has been completed and all clusters have been assembled into the core. All unloaded core elements for NRX-A1 including elements modified for instrumentation were received. Eighty percent of the loaded

elements for NRX-A2 are now in process. A round trip shipping demonstration test was conducted between Large and the MAD building (NRDS). (auth)

10885 (WANL-QC-PRES-4223) CONTROL OF REACTOR QUALITY. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1963. 31p. Dep. NTIS $4.75.

Declassified 7 Sep 1973.

Management procedures for maintaining quality control in the NERVA program from the drawing board to the point of use are outlined: Evaluation of suppliers, control (by review) of procurement documentation, surveillance of suppliers, receiving inspection, etc for outside suppliers and detailed in-process inspection of their own operations. Special procedures are given for the disposition of non-conforming material and parts that need reworking. Surveillance for shock during transport is required and the detailed inspection of the test article at the test facility is defined. (LTN)

10886 (WANL-TME-006) RADIATION SOURCES FOR E-MAD BUILDING MAIN BAY SHIELDING. Ricks, L. O. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 Jan 1962. 5p. Dep. NTIS $4.00.

For engineering design of the E-MAD hot cells, some shielding calculations were made. The radiation penetrating the proposed concrete shield approximately six feet thick is almost entirely (95 percent) the high energy group (2.5 mev), for which the attenuation coefficient is 0.0947 per cm. Various methods of calculating the shielding thickness required were within 5 percent of each other (72″ to 76.5″), which nevertheless will affect the dose rate by a factor of 2.2. In view of possible differences of density and composition of the concrete, uncertainties in the calculation and source strength and AEC radiation limits (100 mr/wk), it is recommended that a safety factor of 2.5 be used to be certain to meet the AEC limit. (LTN)

10887 (WANL-TME-007) RADIATION LEVELS OF REACTOR COMPONENTS AFTER SHUTDOWN. Ricks, L. O. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Feb 1962. 2p. Dep. NTIS $4.00.

In order to determine the shielding requirements of the E-MAD building, the maximum gamma radiation levels expected at the surface of reactor components after 3 equally spaced, 20-minute, full power runs followed by a 24 hour decay period. For most NERVA components, the gamma radiation at the surface is of the order of 10,000 R/hr; however, for the reactor core surface the level is 10^6 R/hr. For the Phoebus reactor with nearly 4 times the power, the levels are about 4 times greater. (LTN)

10888 (WANL-TME-010) SHIELD CAPSULE THERMAL ANALYSIS. Pugliese, D. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Feb 1962. 6p. Dep. NTIS $4.00.

A detailed thermal analysis was made on the lithium hydride shield geometry which is being developed for the flight engine of the NERVA project, taking account of the radiation heating in the different materials and the hydrogen cooling. (LTN)

10889 (WANL-TME-013) COMMENTS ON CONVAIR RIFT REPORT. Capo, M. A. (Westinghouse Electric Corp., Pittsburg, Pa. (USA). Astronuclear Lab.). 5 Feb 1962. 2p. Dep. NTIS $4.00.

While WANL's unshielded radiation doses agreed with the Convair calculations, the shielded doses differed appreciably, with the Convair gamma data being about 50 percent higher than WANL data and the neutron flux 250 percent lower. WANL calculations made on Convair's design do not agree with Convair's calculations. Also they wonder about secondary gamma production in the uranium used in the shield. They find the shield weight information confusing and disagree on the radiation heating in the shield by a factor of more than 10. (LTN)

10890 (WANL-TME-015) COMPARISON OF WESTINGHOUSE, CONVAIR AND LOCKHEED RIFT SHIELDING STUDIES. Ricks, L. O. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Feb 1962. 1p. Dep. NTIS $4.00.

Shielding design study results by the three companies are compared. The results involve shield material, shield weight, attenuation, propellant heating, etc. (LTN)

10891 (WANL-TME-019) EQUIVALENT ENGINE RADIATION SOURCES. Ricks, L. O. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Feb 1962. 6p. Dep. NTIS $4.00.

For preliminary design of test facilities, approximate point source neutron and gamma fluxes and simple energy spectra (energy in several energy ranges) from an operating and shutdown NERVA and PHOEBUS reactor are presented. A graph shows the change in the shutdown source with time. The methods of calculation are described briefly and lead to an accuracy qualification for the flux at short distances (less than 20 feet). (LTN)

10892 (WANL-TME-086) GAMMA RAY SOURCE ENERGY SPECTRUM FOR NERVA. Capo, M. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Jul 1962. 2p. Dep. NTIS $4.00.

For use in shielding analysis the total gamma energy per fission in a NERVA reactor is given and also the energy in each of thirteen energy groups. The values include contributions from prompt gammas, short half life gammas, delayed gammas (assuming a 20 minute reactor run), and gammas from capture in uranium 235. Capture gammas in other core materials are neglected. (LTN)

10893 (WANL-TME-093(Suppl.1)) POST-OPERATIVE CELL REQUIREMENTS AT E-MAD BUILDING. Svasek, A. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Aug 1962. 22p. Dep. NTIS $4.25.

In order to attain maximum utilization of the information obtained during the post-operative tests, of the NRX-A reactor it will be necessary to evaluate prior to the test, many of the same components examined during the post-operative tests. It is proposed that the following evaluations should be accomplished during a pre-test examination of the core and the documentation shipped to the post-operative cells at the E-MAD facility: Weights of components, dimensions of components, radiography, ultrasonic testing, flow testing, borescopic inspection, and visual inspection. In addition, on each batch or grouping of components fabricated, the following destructive tests should be performed: Hardness Testing, Tensile and/or Bend Testing, Stress Rupture Testing, Fatigue Testing, Thermal Conductivity Testing, Thermal Expansion Testing, Wear Testing, Corrosion Studies, Impact Testing, and Metallography (Structure and Porosity). It will also be necessary that the preliminary data be properly documented and that each cluster, fuel element, tie rod, etc. be properly identified so that the markings can be read before and after the test. In the same manner, it will be necessary that post-operative examinations be properly documented thus enabling the data evaluation to be accomplished in other areas or locations than the post-operative cells. (auth)

10894 (WANL-TME-104) REVIEW OF VITRO'S PRELIMINARY E-MAD FACILITY NUCLEAR SHIELDING REPORT. Ricks, L. O. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Aug 1962. 4p. Dep. NTIS $4.00.

The E-MAD facility as proposed by Vitro Engineering Company has been reviewed from a shielding point of view and found to be adequate for a NERVA or Phoebus engine under normal operating conditions with the possible exceptions of radiation penetrating the upper main bay walls and scattering to the main bay operation galleries; radiation penetrating the low density section of the main door (122/1) and scattering to the ground outside the building; and radiation scattering on the main bay floor and streaming through the 1/2″ slot below the main door. The design analysis does not appear to cover special circumstances such as the core or activated engine components in elevated positions. (auth)

10895 (WANL-TME-349) NRX OPERATING LIMITS. Arnold, W. H. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 May 1963. 5p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

The attached table of temperature, flow and pressure limitations at the specified reactor locations are preliminary values applicable to the NRX-A reactor, provided in advance of the E-engine reactor model to be prepared later. Good engineering practice dictates that these limits should not be exceeded. (auth)

10896 (WANL-TME-409) NUCLEAR SAFETY CONSIDERATION FOR NERVA REACTOR ASSEMBLY AT WANL. Arnold, W. H.; Hemmerle, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Apr 1963. 10p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

Procedures at WANL for avoiding criticality in the assembly and shipping of reactors and fuel elements are described. A maximum of 20 fuel elements is permitted on an assembly table at one time. (25 elements under favorable conditions are needed for criticality). After the clusters are assembled, poison wires are installed. Special storage racks and trays have been provided. For shipment, the clusters are installed in a suitcase and these in turn into a bird cage. (LTN)

10897 (WANL-TME-552) PRELIMINARY REPORT OF STATIC LOAD TESTS ON THE PLASTIC MODEL OF THE NRX-B

FORGED BASE PLATE. Krebs, A. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Sep 1963. 21p. Dep. NTIS $4.25.

Declassified 11 Sep 1973.

Static load tests performed on a plastic model base plate are described. Included are the general test procedures, significant results and conclusions. The experimentally determined stress and deflection data obtained in these tests will be used to substantiate analytically determined stress and deflection values and to optimize the structural design of the base plate. (auth)

10898 (WANL-TME-554) PRELIMINARY TEST REPORT ON THE A/1 TESTS. Davis, G. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Oct 1963. 13p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

Various mechanical properties (flexural strength, compressive strength, Young's modules, fatigue) were determined on 32 fuel elements from the Westinghouse Cheswick plant. The values were slightly higher than published results of similar tests. (LTN)

10899 (WANL-TME-555) FUEL CLUSTER ASSEMBLY MECHANICAL TEST. Preliminary Report. Gesinski, L. T. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Sep 1963. 12p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

A full-length seven fuel element cluster assembly with simulated lateral support was excited laterally and a preliminary study of its response characteristics was made. A brief investigation of resistance to wear of a niobium coated cluster under vibratory motion was made. (auth)

10900 (WANL-TME-557) A 5 MECHANICAL TEST OF CORE SUPPORT BLOCK. Preliminary Report. Lee, D. Y. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Sep 1963. 12p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

Seven coated and seven uncoated regular configuration interlocking support block assemblies were statically tested to destruction under ambient conditions. The arithmetical mean failure load for the niobium coated blocks is 4010 lbs with a minimum of 3725 lbs and a maximum of 4480 lbs. The uncoated block strengths are approximately 5% greater with a mean failure load of 4170 lbs, a minimum of 3850 lbs and a maximum of 4650 lbs. The calculated standard deviations are 230 lbs and 260 lbs for the coated and uncoated blocks respectively, so the difference is not statistically significant. Using the amplifying system and interim inspections before complete failure, it was determined that the support block seat is the area where initial failure occurs. This confirms the validity of the design changes initiated from the developmental tests conducted. The increase in the pyrolytic cup bearing surface and an addition of a pyrolytic bearing washer has conclusively proven that the pyrolytic parts which were the weakest in the block assembly have been strengthened beyond that of the block itself. (auth)

10901 (WANL-TME-558) PRELIMINARY REPORT, A-6 TIE ROD TEST. Davis, G. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Sep 1963. 54p. Dep. NTIS $5.75.

Declassified 11 Sep 1973.

Static tensile tests, conducted on NRX-A and backup tie rods at temperatures ranging from −320°F to 1250°F, show results similar to published data except at temperatures approaching 1200°F, where test values were significantly less. Preliminary axial fatigue tests conducted on NRX-A tie rods at various preload and alternating loads, and at ambient and 900°F temperatures, have demonstrated 10^5 cycle endurance limits considerably in excess of anticipated design loads. In preliminary tests, the relationship between lateral vibration resonant frequency and axial tensile load has been practically independent of the tie rod temperature for the range −320°F to 900°F. (auth)

10902 (WANL-TME-559) PRELIMINARY REPORT CY 63, A-1 FUEL ELEMENT TESTS. Davis, G. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1964. 71p. Dep. NTIS $6.75.

Declassified 11 Sep 1973.

Since stress concentrations and/or seemingly minor variations in manufacturing processes could cause significant variations in the strength properties of graphite fuel elements, a battery of sophisticated tests (A-1 series) has been developed for fuel element testing and the initial results are reported. The tests include dynamic Young's modulus (using axial or lateral deflections, dynamic shear modulus, compression and tensile strength tests, vibration-clearance test and a destructive fatigue test. The initial results of these powerful dynamic tests have indicated homogeneous material in the fuel elements, good quality control and a strength 25 to 50 percent greater than previously indicated by other tests. Fatigue tests have indicated an endurance strength in excess of 3000 psi. Vibration-clearance tests approximating reactor conditions indicate satisfactory element life for any element support system other than cantilever. The test equipment is described, formulae are given and the initial results presented in graphs and tables. (LTN)

10903 (WANL-TME-561(Add.2)) WANL FUEL MATERIAL IRRADIATION PROGRAM. Capsule Series T-T: Phase I. Addendum II. Jacobs, D. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Jan 1964. 13p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

A thermal analysis of WANL fuel irradiation experiments was carried out. A coolant flow rate of 7.69 gpm is more than sufficient to prevent boiling within the water annulus of the capsule assembly. This flow can be delivered by the coolant delivery system. Burnout would not occur even if there was a complete loss of coolant water during such irradiation. (LTN)

10904 (WANL-TME-573(Add.1)) TRANSCRIPT OF QUESTIONS AND ANSWERS DURING CONTRACT YEAR 1963 SUMMARY MEETING, OCTOBER 22–23, 1963. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Nov 1963. 51p. Dep. NTIS $5.75.

Declassified 11 Sep 1973.

10905 (WANL-TME-574) NUCLEAR DATA LIBRARY FOR THE FISSION PRODUCT PROGRAM. Trammell, M. R.; Henninger, W. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1963. 52p. Dep. NTIS $5.75.

The Table of Nuclear Data for use in NERVA development includes the atomic number and chemical symbol, mass number, half-life, decay constant, fission yield, β-spectrum, and γ-spectrum of each nuclide. (auth)

10906 (WANL-TME-579) ANALOG COMPUTER MODEL OF NRX-A FEEDSYSTEM WITH MIXING CHAMBER. Steiner, G. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Oct 1963. 38p. Dep. NTIS $5.00.

Declassified 11 Sep 1973.

The simple analog computer model of the mixing chamber was designed for operation in the range of 80° to 100°R mixing chamber exit temperature and pressures of 200 to 800 psi. Within this range, and total hydrogen flow above 30 lb/sec, the model appears to be sufficiently accurate to predict the system behavior, and to permit its use for the analysis of temperature control equipment. The mixing chamber model did not show oscillatory behavior at low flows as tests of the system at the Test Site showed. However, the addition of some improvements to the mixing chamber model may increase its accuracy and range to include this problem area uncovered in tests on the system at the Test Site. (auth)

10907 (WANL-TME–601) OPERATING LIMITS FOR NRX REACTORS. Kemp, S. N.; Mack, R. J.; Sadler, J. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1963. 26p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

The operating limits of the NRX reactors are defined. Included are a general description of the NRX-A reactors and the facility in which they will be tested; a discussion of the reactor and facility operating variables and their limitations; and the procedural controls used to insure compliance with these limitations. (auth)

10908 (WANL-TME-605) PHASE I FLOW INDUCED VIBRATION TESTS. Cherish, P.; Hindle, R. A.; Holmgren, J. D.; Leff, G. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 60p. Dep. NTIS $6.00.

Declassified 11 Sep 1973.

A seven cluster core simulating the design features of NRX-A1 was flow tested over the range of 0.32 to 0.61 pps of hydrogen with core inlet pressures from 70 to 310 psia. Motion pictures taken at 64 frames per second of the nozzle end of the seven fuel clusters showed that flow induced vibrations did not occur during either transient or steady state conditions. Core longitudinal pressure distribution data was obtained for the lateral support and seal system. The experimental data was in good agreement with analytical solutions based on the dimension core model. (auth)

10909 (WANL-TME-618) WANL PRESENTATION FOR THE SHIELD DESIGN CRITERIA MEETING, SNPO-C, NOVEMBER 19–20. Capo, M. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1963. 38p. Dep. NTIS $5.00.

Declassified 10 Sep 1973.

A review of the radiation levels outside the flight shield indicates that no insurmountable development problems exist for compo-

nents located above the shield. Comparison of the radiation environment at 10 feet from the NRX-A2 reactor core with the flight shield and the aluminum mockup shield showed that: The gamma ray attenuation for both shields is essentially the same; i.e., a factor of 20 on the shield centerline; the fast neutron attenuation on the centerline is a factor of 630 for the flight shield and a factor of 22 for the aluminum mockup shield; and the extra-core gamma rays from either shield increases the total gamma ray dose rate on the centerline by about 50%. A detailed analysis of the heat deposition in an actuator located above the flight shield showed a total of 290 watts of heat deposited. A comparison of total integrated propellant heat deposition shows that the flight shield attenuates the energy deposition by about a factor of 16 while the aluminum mockup shield attenuates a factor of 7. Thus, the flight shield somewhat exceeds the design condition of 90% heat reduction and the aluminum shield does not quite meet the design condition. Typical temperature rises are 30, 2.5, and 1.4°F for the unshielded, aluminum, and flight shields, respectively with no residual hydrogen in the tank, complete mix model, and 10.5 foot separation distance. The flight shield also eliminates the steep heating gradient in the propellant tank. (auth)

10910 (WANL-TME-621(Rev.600-0)) CRITICALITY MANUAL. (Westinghouse Electric Corp., Cheswick, Pa. (USA)). 17 Nov 1967. 152p. Dep. NTIS $10.75.

Declassified 10 Sep 1973.

Both man and geometry control criteria are used along with other limitations and restrictions within a criticality zone of limited area, particularly with respect to storage or arrangement of material in process in approved containers or storage devices. The work area is divided into criticality zones with limits on the amount of fissionable material in each zone and on the transfer of material between zones. Special controls apply to scrap, contaminated material (e.g., vacuum pump oil), dusts, spills, vacuum cleaner residues, etc. (LTN)

10911 (WANL-TME-622) PLAN OF APPROACH FOR NERVA FLEXIBLE CRITICAL EXPERIMENTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1963. 71p. Dep. NTIS $6.75.

Declassified 10 Sep 1973.

Areas in which the proposed Flexible Critical Experimental Facility (FCX) can contribute to meeting the NERVA engine requirements are described. To this end, each of the major problem areas in the NERVA program has been delineated and the value of FCX in reducing the nuclear uncertainties discussed in detail. An extensive description of the facility is included. Three basic types of critical FCX assemblies are described and the experiments and measurements designed to yield the desired information are enumerated. A discussion of the accuracy in nuclear parameters required to meet program objectives is given, as well as a listing of estimated uncertainities in the various proposed experiments. The report is directed, primarily, at describing those experiments possible with the initial set of fuel elements. Future experiments involving the use of fuel elements containing different uranium loadings necessary for future investigations are also presented. (auth)

10912 (WANL-TME-629) RADIATION EFFECTS PROGRAM REVIEW. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Dec 1963. 350p. Dep. NTIS $20.50.

Declassified 10 Sep 1973.

The NERVA research programs involving radiation effects on reactor instrumentation, reactor components and reactor materials are reviewed in detail. The programs involve using several available test reactors with different characteristics. Some items will be exposed at cryogenic conditions. In many cases radiation heating will be significant and, without adequate cooling, may be sufficient to result in damage. (LTN)

10913 (WANL-TME-633) NRX-A CORE SUPPORT SYSTEM STATIC LOAD TESTS. C2 General Test Plan. Krebs, A. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Nov 1963. 55p. Dep. NTIS $5.75.

Declassified 10 Sep 1973.

The test plan for fulfilling the requirements for the static load test of the core support system is described. The plan involves three major tests, namely: (1) the axial load test, (2) the lateral load test, and (3) the thermal test. The test objectives consist essentially of proof-testing and measuring stresses, deflections, and thermal gradients of the test specimens at anticipated operating temperatures, loads and environments. (auth)

10914 (WANL-TME-644) NRX-A1 TEST PREDICTION. Howarth, W. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1964. 492p. Dep. NTIS $27.75.

Declassified 10 Sep 1973.

The NRX-A1 reactor is to be tested at the Nuclear Rocket Development Station. The extensive test program consists of four basic series of tests—a Phase I test (an ambient gas test), a Cold (95°R) Hydrogen Test, a Liquid Hydrogen Test, and a Phase II Test (a more severe ambient gas test). The total number of run profiles for these tests is 27. All instrument data (pressure, temperature, pressure drop and displacement) have been predicted for these run profiles. The results have been plotted in the form of curves. Each run profile has "quick look" prediction curves and complete reactor prediction curves. In addition to the predictions, the following pertinent information is given: test conditions and sequence of testing; discussion of the reactor flow path; reactor flow path characteristics and their origin; method of core orificing, and manufacturing variations and their effects; a summary of the NRX-A1 instrumentation; and reactor limitations. (auth)

10915 (WANL-TME-645) COMPARISON OF ANALYTICAL AND EXPERIMENTAL FLOW INDUCED CORE VIBRATIONS. Pierce, B. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1964. 29p. Dep. NTIS $4.50.

Declassified 12 Sep 1973.

Comparison of analytical and experimental flow-induced core vibrations has been made for all applicable tests performed to date. These include the KIWI B-4A and B-4B reactors, the KIWI PIE tests and the A-11 component tests. It can be concluded that the analog and experimental results are in good agreement. Similar calculations on the NRX-A reactor design indicate that vibrations will not occur. (auth)

10916 (WANL-TME-646) CRITICALITY HAZARDS CONTROL PROCEDURE. Freidhof, W. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1964. 43p. Dep. NTIS $5.25.

Declassified 12 Sep 1973.

The controls governing the handling, storage, and processing of fuel at WANEF are documented. They will ensure safety from criticality hazards during handling operations by limiting the amounts of fuel in a particular area at one time, by limiting the areas where fuel may be handled, and by ensuring that all people handling fuel are thoroughly indoctrinated in the hazards involved in fuel handling. The fuel limits have been established to limit storage arrays and the total elements, either full length or partial elements, allowed in a "criticality zone" at any given time. The various areas where fuel may be stored or processed are clearly marked signs indicating the limits and by "Crit-Zone" tape or other physical barriers which define the area. (auth)

10917 (WANL-TME-646(Rev.A)(App.)) CRITICALITY HAZARDS CONTROL PROCEDURE. Appendix. Kovacik, W. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1966. 17p. Dep. NTIS $4.00.

Declassified 12 Sep 1973.

The nuclear safety analysis of (1) the WANEF storage vault containing fuel material in shipping containers separated by cadmium, (2) fuel element clusters in aluminum tubes one foot apart on special storage racks, and (3) fuel elements in process (not in containers or storage racks) is presented for dry and flooded conditions (although the latter are extremely unlikely). The storage vault and racks are safe. When fuel elements are handled outside these containers, 33 fuel elements form a critical mass so, using a safety factor of 2.3, it is concluded that a limit of 14 fuel elements should be used. The possibility of criticality in a vacuum cleaner is also considered. (LTN)

10918 (WANL-TME-646(Rev.B)(App.)) NUCLEAR SAFETY MANUAL. Appendix. Kovacik, W. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1967. 33p. Dep. NTIS $4.75.

Declassified 12 Sep 1973.

The directives presented have been established to ensure that a criticality hazard does not arise at WANEF by improper handling or storage of fuel at the facility during the course of the critical test programs. These rules and regulations, coupled with the procedures presented in the WANEF Operations Manual, WANL-TME-267, will ensure that nuclear safety is maintained at WANEF during all operations dealing with fuel. (auth)

10919 (WANL-TME-649) EVALUATION OF PLASMA-SPRAYED PYROLYTIC GRAPHITE COMPONENTS. Goodspeed, R. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Jan 1964. 28p. Dep. NTIS $4.50.

Declassified 12 Sep 1973.

As-deposited pyrolytic graphite insulating sleeves and cups, manufactured by the "plasma-spray" process, were evaluated for visual appearance, dimensional conformance, spectrographic analysis, microstructure, and across-grain thermal conductivity.

As the components were all under-deposited, with respect to desired wall thickness, this evaluation of the "plasma-spray" process and the resulting product is not completely satisfactory. While the process appears to have the potential for solving several problems presently encountered in conventionally deposited pyrolytic graphite components for NERVA reactors, it will require further development before its potential can be realized or completely evaluated. (auth)

10920 (WANL-TME-650) RELEASE OF FISSION PRODUCTS FROM WANL CAPSULE FP-4. Rymer, G. T.; Henninger, W. A.; Grandy, G. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1964. 21p. Dep. NTIS $4.25.

Declassified 12 Sep 1973.

As a result of diffusion of the nuclides or their precursors, the fractional release of the following fission products was substantial and was determined during irradiation at 2200°C: barium 140, strontium 89, cesium 137, cerium 144, yttrium 91 and zirconium 95. More than 90 percent of strontium 89, barium 140 and cesium 137 was released from irradiated NERVA fuel which was then heated to 2000°C in vacuum for 30 minutes; no release of zirconium 95 or molybdenum 99 occurred. Thus, the elements can be arranged in groups which are nearly all released, partially released or barely released. This information is necessary for determining diffusion parameters, the release of fission products from operating reactors, and in predicting the release of fission products during reactor excursions. (LTN)

10921 (WANL-TME-652) IRRADIATION BEHAVIOR OF NERVA SHIELD CAPSULES. Jacobs, D. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Jan 1964. 60p. Dep. NTIS $6.00.

Declassified 12 Sep 1973.

A total of twelve standard length NERVA shield capsules were irradiated. Ten capsules contained cold pressed LiH pellets and two contained sintered LiH pellets. The integrated thermal neutron fluxes achieved varied between 10^{15}n/cm^2 and 3×10^{16}n/cm^2. The in-pile centerline temperatures varied between 100°C and 250°C. At temperatures less than approximately 130°C and integrated fluxes up to 2.0×10^{16}n/cm^2, no swelling was observed. At the higher temperatures the extent of swelling increased with temperature and integrated flux. A maximum diametric expansion of 3.06 per cent was observed on sections of shield capsules irradiated at 240°C to a total dose of 3.3×10^{16}n/cm^2. The capsules containing the sintered pellets swelled less than those containing cold pressed pellets. There were no changes in capsule dimensions as a result of post-irradiation heating up to 300°C. (auth)

10922 (WANL-TME-660) RADIATION LEVELS IN THE ACTUATOR. Nassano, R. N.; Capo, M. A.; Soltesz, R. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1964. 16p. Dep. NTIS $4.00.

Declassified 12 Sep 1973.

Radiation levels were calculated at various locations within the General Electric control drum actuator (Model AG20) for the flight type shield (lithium hydride-steel) and for the test mockup shield. The total neutron flux is as much as a factor of 50 higher for the aluminum shield. The information was required to estimate the radiation heating at various locations within the actuator. In general, it was 10 percent higher with the aluminum shield. (LTN)

10923 (WANL-TME-662) REQUIREMENTS FOR CAPSULE DISASSEMBLY AND POST-IRRADIATION ANALYSIS. Fuel Irradiation Program, Series T-T. Phase I. Jacobs, D. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 23 Jan 1964. 10p. Dep. NTIS $4.00.

Declassified 12 Sep 1973.

The Westinghouse Post-Irradiation Facility will receive six irradiation capsules directly from the GETR. Each capsule will contain three samples of irradiated fuel material. The capsules are to be disassembled within the hot cells and various chemical analyses and metallographic examinations are to be performed upon the fuel. The work required is outlined. (auth)

10924 (WANL-TME-668) PROPOSED PLAN FOR POST-MORTEM EVALUATION OF NRX-A2 FUEL ELEMENTS. Simmons, C. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Jan 1964. 30p. Dep. NTIS $4.50.

Declassified 12 Sep 1973.

Pre- and post-test selection of fuel elements for examination is discussed. The tests to be performed are listed (visual examination, weight change, dimensional change, flow channel changes (corrosion, cracking, etc.), flexural strength changes, microstructural changes, chemical composition changes, thermal conductivity change, thermal expansion change, lattice parameter changes, fuel diffusion, etc.). (LTN)

10925 (WANL-TME-684) VARI-QUIR II: SPACE-TIME NEUTRON DIFFUSION WITH FEEDBACK. Riese, J. W.; Collier, G.; Dickson, P. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1964. 45p. Dep. NTIS $5.25.

Declassified 12 Sep 1973.

The code VARI-QUIR was written to solve the diffusion equation, in space and time, for up to 4 energy groups and 6 precursor groups. Improvements to, and refinements in, the neutronics code itself are presented with additions to the code of the non-neutronics equations describing the fluid flow in a NERVA reactor, and the "feedback" effects of temperature, hydrogen density, and solid density on the reactivity. (auth)

10926 (WANL-TME-687) NUCLEAR SAFETY DESIGN OF THE ASTROFUEL VAULT USING BORAL SPACERS. Vachon, L. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 4 Jun 1964. 11p. Dep. NTIS $4.00.

Declassified 12 Sep 1973.

The Astrofuel vault arrangement for in-process fuel elements will not provide the storage capacity required for anticipated production levels. The nuclear safety design of a storage configuration utilizing nuclear poison is presented that will permit a substantial increase in storage capability while maintaining protection against criticality under various conditions of flooding. (auth)

10927 (WANL-TME-691) NRX-A CANDIDATE DIAGNOSTIC TRANSDUCERS IRRADIATED AT PLUM BROOK REACTOR FACILITY CYCLE 4 (PB No. 1W). Grimm, D. E.; Solberg, D. E.; Stephens, A. G (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 6 Apr 1964. 38p. Dep. NTIS $5.00.

Candidate reactor instrumentation (strain gages, thermocouples, resistance thermometers) were irradiated at the Plum Brook Reactor Facility (reactor cycle 4, PB No. 1W). Five of the eight strain gages provided no useful information because of low insulation resistance. The other three did not indicate any specific effect of the high radiation environment. The resistance thermometers deviated from the true results, probably due to radiation heating. The radiation affected the insulation resistance of the thermocouples, but not to a serious degree. (LTN)

10928 (WANL-TME-709) SINGLE SEAL HIGH PRESSURE ISOTHERMAL TEST (B-3, LATERAL SUPPORT SYSTEM). Initial Test Results. Ferris, J. R.; Steffen, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Mar 1964. 41p. Dep. NTIS $5.25.

Declassified 12 Sep 1973.

An isothermal hydrogen flow experiment is reported which gives flows and pressure losses across a seal segment in the lateral support and inner reflector system and across the associated plunger annuli, both representative of those in the reactor. (auth)

10929 (WANL-TME-710(Rev.B)) RADIATION EFFECTS DATA BOOK. (Revision B). Zorn, J. B. (Comp.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Jul 1965. 46p. Dep. NTIS $5.50.

Declassified 12 Sep 1973.

Additions to the "Radiation Effects Data Book" involve determinations of effects on pressure transducers, control vane tensile specimens and O-ring seals. The limiting condition for satisfactory operation of the transducers is a high coil temperature (about 800°F) caused by gamma heating. It was concluded that radiation effects of engineering significance would not develop in control vanes from NERVA operation at full power for 20 minutes. While the nature of the silicone rubber was altered by the irradiation and all specimens ultimately fractured in a brittle manner, they retained such relatively good strength properties and a fair degree of elastic toughness that it is believed they will sustain the maximum compressive load anticipated in service. (LTN)

10930 (WANL-TME-730) ANALOG-COMPUTER STUDY OF FAST RETREAT AND OTHER SHUTDOWN MODES FOR NRX-A2 POWER TESTS. Rovnak, J.; Gurski, P. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 Mar 1964. 61p. Dep. NTIS $6.25.

Declassified 11 Sep 1973.

The results of an electronic-analog-computer study predicting the transient performance of the NRX-A2 reactor system during a typical startup, and also during three different shutdown modes, are presented. The three shutdown modes, designated as Normal Retreat, Fast Retreat, and Scram, are characterized by the amount of time required to accomplish the shutdown. The retreat modes are implemented by traversing the normal startup profiles (power, flow, and temperature demand) in the reverse direction. This is accomplished by reversing the direction of rotation of the program

drums. The dynamic behavior of the NRX-A2 system was predicted by employing analog models of the Test Cell A feedsystem, the NRX-A reactor, and the power, flow and temperature controllers. The models were coupled together to form an integrated NRX-A2 system simulation. The objectives were to predict the transient behavior of the NRX-A2 system during a normal power startup and also during each of the three shutdown modes previously mentioned. In addition, a fast shutdown procedure was developed which was less likely to result in reactor damage than the Scram or Emergency shutdown. (auth)

10931 (WANL-TME-768) STRUCTURAL EVALUATION OF THE INNER REFLECTOR. Parker, W. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1964. 79p. Dep. NTIS $7.00.

Declassified 11 Sep 1973.

During operation of the nuclear reactor engine, the inner reflector graphite cylinder is subjected to an axially varying pressure distribution. Compressive stresses of sufficient magnitude to cause instability and failure are possible. A series of experimental investigations were therefore required to substantiate the structural integrity of the inner reflector. Tests were designed to subject the reflector to uniform pressure differentials along its outer periphery to determine the rate of gas diffusion (permeability rate) through the wall thickness for pressure ranges of 0 to 100 psig and the structural integrity of the reflector at pressure ranges from 0 to 200 psig. The reflector was also subjected to a series of simulated pressure load environments. All tests were conducted at ambient temperature. Results indicate that the design of the inner reflector is satisfactory for NRX-A1 and NRX-A2 reactor operation. Permeability tests indicated that the inner reflector should be impregnated following the final machining operation. (auth)

10932 (WANL-TME-773) REVIEW OF NRX-A1 THERMAL AND FLUID FLOW PERFORMANCE AND ITS EFFECT ON NRX-A2. Blivin, C. R.; Boman, L.; Davidson, S.; Howarth, W. L.; Wright, M.; Zemanick, P. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Jun 1964. 85p. Dep. NTIS $7.25.

Declassified 11 Sep 1973.

Based on a review and analysis of NRX-A1 test data, it may be concluded that there are no major thermal or fluid flow problems which will affect NRX-A2 operation. Control drum sticking and high control drum torques occurred during the cold (90°R) hydrogen and liquid hydrogen transient NRX-A1 tests. However, during the final cold hydrogen test series, two flow profiles were demonstrated which included a slow pre-chill and eliminated the high torques and control drum sticking. One of these proven flow profiles will be used for the NRX-A2 startup, therefore excessive control drum torques are not expected. No evidence of flow-induced vibration in the NRX-A1 has been discovered. On the basis of a review and analysis of the NRX-A1 thermal and fluid flow results, there are no restraints on the assembly and test of NRX-A2. (auth)

10933 (WANL-TME-785) PARAMETRIC STUDY OF FUEL ELEMENT PROBABILITY OF SURVIVAL FOR THE NRX-A CORE. Swanson, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1964. 17p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

A summary of calculations predicting the probability of fuel element failures in NRX-A cores due to mechanical and thermal stresses is reported. For convenience, the core is considered as two separate regions: Peripheral fuel elements which are in contact with the filler strips, and the region consisting of the balance of the fuel elements. Using Weibull's theory, the failure probabilities are calculated separately for the two regions and the resulting failure probabilities are added to obtain the total failure probability for the entire core. Details of the stress distributions and the calculational procedure are given. The analysis does not consider vibration stresses or the effect of hydrogen corrosion. The analysis also does not consider some beneficial second order effects, such as the reduction of the lateral pressure on a cold element due to lateral contraction and the axial compression of the cluster preload springs. (auth)

10934 (WANL-TME-789) APPROXIMATE METHOD FOR DETERMINING STATIC STRESSES IN REGULAR SUPPORT BLOCK (BASED ON PLATE ANALYSIS). Parker, W. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1964. 40p. Dep. NTIS $5.00.

Declassified 11 Sep 1973.

During nuclear reactor operation, the support block is subjected to static, dynamic and thermal loadings. A method for predicting the stresses in a regular support block subjected to static pressure loadings is demonstrated. A computer program has been developed, based upon this solution, from which numerical results have been obtained. A comparison is included between the predicted theoretical failure load for the block and experimental values obtained during the A5 Test Series (Support Block Structural Integrity–Mechanical and Thermal Tests). (auth)

10935 (WANL-TME-832) ANALYSIS AND DESIGN SIGNIFICANCE OF IMPEDANCE RING LOSS COEFFICIENT COMPONENT TEST RESULTS. Miller, A. I. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1964. 8p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

Experimental test results of the pressure loss coefficients for the impedance rings in the inner reflector-outer reflector and outer reflector-pressure vessel annuli and the analytically predicted values compare favorably. Recommended pressure loss coefficients (based upon the impedance area) are given. (auth)

10936 (WANL-TME-834) WANL FUEL MATERIAL IRRADIATION PROGRAM. Capsule Series T-T. Phase II. Safeguards Report. Jacobs, D. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1964. 46p. Dep. NTIS $5.50.

Declassified 10 Sep 1973.

The safeguards analysis of the proposed fuel irradiation program has been made in as general a fashion as possible. A wide range of irradiation conditions have been considered. The most limiting factor was found to be the stresses developed within the inner stainless steel can. It was shown that the lower limit of the range of tensile yield stress for 304 stainless steel is reached at an unperturbed thermal neutron flux of $8.6 \times 10^{13} n/cm^2$ sec. At this flux the fuel centerline temperature will be 6000°F (3,250°C). There is no danger of burnout at the maximum allowable conditions. All possible hazardous situations related to the insertion of the capsule assemblies have been considered. It has been shown that all incidents are provided for by the WANL-GETR instrumentation system. Consequently, it may be concluded from the foregoing, that the WANL capsule assemblies can be exposed to unperturbed, thermal neutron fluxes up to $8.6 \times 10^{13} n/cm^2 sec$ with no hazard to the GETR. (auth)

10937 (WANL-TME-844) SUMMARY OF INSTRUMENT TRANSDUCER QUALIFICATION FOR NRX-A2. Kirschbaum, H. S.; Kalapaca, H. P.; Weldon, T. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 57p. Dep. NTIS $6.00.

Declassified 10 Sep 1973.

All the instrument transducers to be used on NRX-A2 have been tested and studied so that the transducers can be installed safely and will provide the required information. All the qualification test information has been collected in summary form. (auth)

10938 (WANL-TME-859) EVALUATION OF THE NRX-A2 NOZZLE INTERFACE SEAL. Libbing, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1964. 12p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

The nozzle interface seal is composed of two flexible U-shaped rings welded together over a central stiffening ring to provide an elastic face seal between the end of the graphite cylinder and the nozzle surface. The seal rings tested are made of 0.022 inch thick Inconel X-750 sheet. The insertion of the nozzle against the seating force of the graphite cylinder axial preload springs at assembly compresses the seal within the confines of a machined groove on the nozzle end of the cylinder. The full pressure drop from the reactor inlet to core exhaust is exerted on the seal due to the pressure relief holes in the graphite cylinder. This pressure acts to spread the U-shaped sections, forcing them against the sealing surfaces. The center stiffening ring which is welded between the two seal halves has eight 1-inch wide tabs which extend beyond the periphery of the seals. These tabs hold the seal in position in the reactor both axially and radially. The areas, between tabs, allow for pressure communication and coolant circulation to each seal half of the nozzle interface seal. Evaluation of this seal shows that the design is adequate to perform the required functions, and since this design is identical to that designated for the NRX-A2, it will fulfill the requirement for the "hot" test. A change in the seal material, from Inconel X-750 for NRX-A1 to Inconel 718 for NRX-A2 was made to take advantage of the better physical and mechanical properties of Inconel 718. (auth)

10939 (WANL-TME-865) FLOW RATE AND PRESSURE DROP CHARACTERISTICS OF AN INCONEL X-750 NOZZLE INTERFACE SEAL. Steffen, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jun 1964. 51p. Dep. NTIS $5.75.

Declassified 11 Sep 1973.

A test performed to determine the hydrogen leakage rate past a nozzle interface seal was run under ambient temperature conditions and at pressure levels ranging from 100 to 700 psia, and pressure differentials ranging from 0 to 220 psia. The seal tested was constructed of Inconel X-750. The leakage was recorded with the seal compressed to reactor specifications, first with aluminum interfaces on the reflector and nozzle side, and second with impregnated H4LM graphite on the reflector side and aluminum on the nozzle side. In both cases the conditions of pressure and pressure differential were the same. Flow rate was materially higher in the second case. (auth)

10940 (WANL-TME-868) NRX-A1 TWELVE WEEK POST OPERATIVE REPORT. DeStefano, J.; Murr, W. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1964. 121p. Dep. NTIS $9.25.

Declassified 11 Sep 1973.

The results of the post-operative examinations performed on the NRX-A1 reactor after cold-flow testing at NRDS are presented. The performance of the reactor hardware and diagnostic instrumentation, with minor exceptions, was considered satisfactory under the conditions of the test environment. There was no damage of a magnitude to require delay or termination of the NRX-A1 tests. The minor hardware damage did not interfere with other hardware, nor did it induce any undesirable stresses in the system. Additionally, there was no excessive vibration as had been experienced in the KIWI-B4A and KIWI-B4ACF test series. Some of the damage noted probably occurred during assembly or disassembly of the reactor. Hardware damage included circumferential and axial fractures of the integral nozzle end spigots of the outer reflector sectors, slight scoring of the control drums, debris blocking fuel element orifices, oil deposits on reactor hardware, and fretting of the filler blocks at the dome end seal contact area. Instrumentation damage was relatively light; the continuity and resistance of all operative instrumentation was, in general, satisfactory. Physical damage included unbonded strain gages, crushed leads, and bent thermocouples and LVDTs. (auth)

10941 (WANL-TME-885) DEVELOPMENT OF AN IMPROVED "BUBBLE THROUGH" SATURATOR. Wilks, P. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jul 1964. 14p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

One of the important process parameters in NbC vapor plating operations is the concentration of the salt in the plating stream. Since the melting point of the salt is about 205°C and its vapor pressure at that temperature is 230 mm of mercury, the molten salt can be conveniently evaporated at temperatures above its melting point. Several types of vaporization schemes have been utilized in ROVER and NERVA fuel element coating. These have in common the passage of a carrier gas through a chamber containing molten niobium pentachloride. In some instances the temperature of the salt has been controlled along with the flow rate of carrier gas. These systems are empirically calibrated to achieve reproducible salt vaporization rates from run to run. At Oak Ridge the vaporizer has been operated at the boiling point of the salt with salt vaporization controlled by heat input in a carefully insulated system. In all these systems an excess of carrier gas, usually helium, is employed. Accordingly, a series of experiments was undertaken to determine if theoretical salt pickup could be achieved, and to establish design parameters for a system capable of delivering precise quantities of salt at rates on the scale of production operations. The results of laboratory-scale tests, and tests of a developmental saturator which was later constructed, are presented. Possible design parameters are discussed for a unit which could be used in routine production. (auth)

10942 (WANL-TME-932) EVALUATION OF PYROLYTIC GRAPHITE USED IN NERVA REACTORS. Goodspeed, R. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 83p. Dep. NTIS $7.25.

Declassified 11 Sep 1973.

Pyrolytic graphite material and thermally insulating components as produced by General Electric Company, High Temperature Materials, Inc., and Super Temp Corporation for the NERVA reactors were evaluated. The evaluation consisted largely of the determination of thermal conductivity at elevated temperatures. Other evaluations included visual examination (for coloration, growth cone structure, deposition defects, intersecting delaminations, and spalling), microstructural examination (for degree of renucleation, uniformity, and number, size, and distribution of nonintersecting delaminations), density determinations, chemical impurity analyses, and special studies when required. The results of this evaluation are reviewed and each manufacturer's products are discussed in detail. During the course of the NERVA program, substantial improvements have been realized in the quality of pyrolytic graphite products, especially the cylindrical sleeves and cups. These improvements have resulted from controlling the type and uniformity of deposition thickness. Excellent components, having only minor intersecting and nonintersecting delaminations, spalling, and deposition defects can be obtained. However, the manufacturing yield is inversely proportional to the level of quality specified. (auth)

10943 (WANL-TME-938) NRX-A2 PROFILES FOR DEMAND PROGRAMMERS. Blake, P. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 3 Sep 1964. 8p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

In response to a revision of NRX-A2 test specifications, demand profiles are presented for use in drawing the actual program drum profiles. The criteria used in establishing the profiles are also presented. (LTN)

10944 (WANL-TME-952) SECTOR THIN WEB SPECIMEN THERMAL SHOCK TESTS. Kallin, I. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1964. 13p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

High thermal stresses were predicted for the outer reflector sector during startup. The thin webs at the control drum cavity are cooled on both their inner and outer surfaces by the cryogenic gas flow entering the reactor. The heavy section of the sector remains close to room temperature for a number of seconds and restrains the thin webs from thermally shortening in the direction of the sector. The result is an axial tensile strain in the thin webs. Under certain reactor startup conditions, such as a liquid hydrogen ramp, it is estimated that a ΔT greater than 210°F between the bulk of the sector and the thin webs can be attained. This ΔT would produce a strain higher than 0.062%, which is the approximate elastic strain for the sector material. Since beryllium is commonly reported to have no ductility at low temperatures, a number of tests were run on a small specimen of beryllium to bracket the ductility of the sector material at operating temperatures. The test results have shown that at about 300°R the specimen tested had a ductility greater than 0.040% and an unknown amount less than 0.161%; and therefore, was able to accommodate a thermal strain equivalent to an elastic thermal stress higher than about 58,800 psi, 19,600 psi in excess of the yield strength of the material. Although plastic strains have been demonstrated for beryllium at cryogenic temperatures, the data is very limited and should be augmented by additional testing with a full sector, rather than small specimens, because this would permit the effects of the actual reflector sector geometry to be investigated under closely simulated reactor operating conditions. (auth)

10945 (WANL-TME-969) EVALUATION OF FOIL-TYPE PYROLYTIC GRAPHITE INSULATING SLEEVES. Goodspeed, R. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Oct 1964. 69p. Dep. NTIS $6.50.

Declassified 10 Sep 1973.

Vapor-deposited and machined, pyrolytic graphite, thermally insulating sleeves for the NERVA reactor have been very difficult to manufacture to specified requirements, resulting in high rejection rates with attendant high costs and poor delivery. Therefore, two experimental lots of NERVA reactor insulating sleeves made from a highly flexible, anisotropic, pyrolytic graphite foil, known as Grafoil-100, were evaluated as potential replacements. The Grafoil sleeves were submitted by High Temperature Materials, Inc. Both lots were evaluated for general appearance, dimensional control, density, bonding, resistance to abrasion, chemical impurity content, thermal conductivity as a function of temperature and of the number of thermal cycles, resistance to thermal gradients, resistance to thermal shock, resistance to hydrogen corrosion, and axial load deformation and resilience behavior. Also, Grafoil-100 in the foil form was investigated for density, chemical impurity content, thermal conductivity and tensile strength. The results indicate that Grafoil sleeves have a great potential as replacements for the conventional vapor deposited pyrolytic graphite sleeves. Besides the inherent advantages of uniformity, the absence of deposition defects, the possibility of being made in longer lengths, and a considerable reduction in procurement lead time and cost, they appear to have satisfactory axial load deformation and resilience characteristics, and resistance to abrasion, thermal gradients, thermal shock, and hydrogen corrosion at 2000°F (1100°C). The areas of concern that remain are the higher and somewhat unstable thermal conductivity and the excessive hydrogen corrosion at 3000°F (1650°C). The vendor is being encouraged to solve these problems. (auth)

10946 (WANL-TME-973) FATIGUE STRENGTH OF GLUE JOINTS ON WAFER-END ELEMENTS AT AMBIENT TEMPERATURE. Final Report. Davis, G. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1964. 7p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

Problems associated with end coating of fueled elements led to a design utilizing an unfueled wafer cemented on the end of the fuel element. Preliminary mechanical strength tests showed that the bond joint was of adequate strength, and the adherence of the end coating was good. A fatigue test of a quantity of typical element joints was set up to insure that the elements would stand up under repeated vibration. The test was intended to establish an S-N curve of the joint strength; however, fuel element material problems prevented fabrication of an adequate number of specimens. The test provided data to bracket the endurance limit at about 880 psi for 2×10^6 cycles, but this value should be regarded as preliminary due to the small number (7) of samples tested. (auth)

10947 (WANL-TME-976) NERVA FUEL ELEMENT PROCESS STUDIES. Feild, A. L.; Hollabaugh, C. M.; Wilks, P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1964. 41p. Dep. NTIS $5.25.

Declassified 10 Sep 1973.

Five different investigations relating to NERVA fuel element development have been oriented from the standpoint of production coating process development and improvement. Attention has been directed also to obtaining a better understanding of the basic coating process mechanisms. It is recommended that fuel element tip lengths of $\frac{1}{2}-\frac{3}{4}$ inches be considered to reduce problems occasionally encountered with the shorter tips used in NRX-A3 production (about $\frac{1}{4}$ inch). Changes in the production coating operational parameters were recommended. This primarily involves the use of a 1900°C inlet temperature for the first hour of the coating run, followed by a drop in inlet temperature to 1600°C as quickly as possible for the remainder of the run. Laboratory coating studies indicate that accurate control of the many variables existing in the coating process is necessary. Most important parameters are element and preheater temperature, gas and vapor flow rates, proper system pressures and optimum run times under specified coating conditions. Study of mechanism and kinetics of NbC formation on fueled graphite shows that, with an excess of reactant available in the vapor stream, the coating thickness is dependent on the rate of carbon diffusion through NbC. This rate is a function of the temperature and increases with increasing temperature. With insufficient reactant present in the vapor stream, coating thickness is dependent on the amount of niobium available for reduction and formation of carbide. In the practical case of coating long, small diameter fuel element channels, the coating thickness is carbon-diffusion controlled for a short distance at the inlet end of the element. For the remainder of the element length, the coating thickness is controlled by gas composition. With an element at uniform temperature throughout its length the coating thickness profile is peaked a few inches from the inlet end and gradually diminishes toward the exit end. (auth)

10948 (WANL-TME-1034) NRX-A COMPONENT TEST PROGRAM. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1964. 113p. Dep. NTIS $8.75.

Declassified 11 Sep 1973.

The Component Test Program has been devised to provide experimental information and test data on these problems considered most crucial to the NRX-A reactor development program. The requirements for this program have arisen primarily from the areas of concern or uncertainty with regard to the existing NRX-A design and its ability to perform satisfactorily under the prescribed reactor test conditions. In addition, testing is planned in support of design modifications being considered for or factored into later designs such as NRX-A5. Major areas of emphasis are: investigation of the hydrogen corrosion behavior of fuel elements, filler strips, support blocks and other graphite components under simulated reactor operating conditions of temperature and hydrogen flow; mechanical testing of graphite components under conditions of simulated reactor mechanical environment and temperature; flow testing of redesigned components as well as further investigation of interstitial and leakage flows; and mechanical testing of concepts for design modifications as well as proof testing of redesigned components. (auth)

10949 (WANL-TME-1051) EXTERNAL CORROSION OF SINGLE ELEMENTS. Kirschner, R. L.; Cheshire, W. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Feb 1965. 8p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

The similarity between the external element corrosion seen at the corrosion facility and that observed in past hot reactor tests indicates that considerable knowledge can be obtained by testing elements in atmospheres of controlled composition. Once the present knowledge has been expanded, and an understanding of the external behavior of fuel elements at the corrosion facility has been attained, this information can then be applied to hot reactor tests. The appearance of this corrosion phenomena in a particular pattern and at a particular portion of the element leads to the feasibility of reproducible tests. Experimental corrosion tests recommended are outlined. (auth)

10950 (WANL-TME-1067) LONG LIFE FUEL DEVELOPMENT PROGRAM. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Dec 1964. 23p. Dep. NTIS $4.25.

Declassified 11 Sep 1973.

The NERVA fuel development program for long life capability fuel elements is described. Three recent achievements are: Successful operation and restart of the KIWI-B4E; successful operation of the NRX-A2; and laboratory demonstration of fuel element lifetimes of 20-30 minutes. One of the major conclusions which emerges is that hydrogen corrosion attack of graphite is one of the basic problems limiting the operational lifetime of NERVA reactors and that fuel development activities may be expected to increase the reactor lifetime. The specific goal of the long life development program is multi-cycle operation for total times of 60-120 minutes. The general approach adopted in the formulation of the long life development program involves detailed examination of the nature of the hydrogen corrosion problem and consideration of development activities to solve various aspects of the problem. The fuel element corrosion problem can be divided into four areas: Corrosion within the coated coolant channels; corrosion on end and side face coatings; corrosion on external surfaces; and corrosion test problems. The corrosion experience and test results are reviewed and thin current research programs are outlined. The major attempt is to develop niobium carbide coatings that will not crack and expose the undeveloping graphite to attack. Fuel element end coatings or bonded wafers are also undergoing development. (auth)

10951 (WANL-TME-1089) SURVEY OF TOP SHADOW SHIELD EFFECTIVENESS FOR A CLUSTER OF THREE NERVA II MODULES. Ricks, L. O. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1965. 50p. Dep. NTIS $5.75.

Declassified 11 Sep 1973.

A feasibility study of clustered NERVA II nuclear rocket modules is described, in which the radiation patterns and propellant heating in a cluster of three NERVA II modules are investigated. The effects of a top shadow shield in each reactor are evaluated. The unshielded radiation levels outside the NERVA II reactor are approximately the same magnitude as for NRX-A. Up to 47% of the unshielded propellant heating is due to radiations from two adjacent reactors, in a three module cluster. A top shadow shield provides limited protection for adjacent propellant tanks, but shows little variation beyond 41 g/cm^2 shield thickness. A top shadow shield of approximately 41 g/cm^2 would reduce the propellant heat to 31% of the unshielded value in a cluster of three modules. (auth)

10952 (WANL-TME-1098) NRX-A CANDIDATE DIAGNOSTIC PRESSURE TRANSDUCERS IRRADIATED AT PLUM BROOK REACTOR FACILITY EXPERIMENT 23/W506 (PBRF CYCLE 22P, No. 8W). Welsh, R. W.; Simoncini, M. V. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1965. 36p. Dep. NTIS $5.00.

The radiation test information and evaluation of two Wiancko variable reluctance differential pressure transducers and two Wiancko variable reluctance absolute pressure transducers are presented. These transducers are being evaluated for NRX applications. The experiment containing these transducers was irradiated at the Plum Brook Reactor on July 29-30, 1964, PBRF Cycle 22P. The Wiancko pressure transducers tested in this experiment appear to operate satisfactorily, provided their coil temperatures remain at a temperature below 800°F. The differential pressure transducers provide better coil cooling and consequently are capable of withstanding greater gamma heating rates before overheating. It is possible that the transducers could be redesigned by the manufacturer (improving heat conduction paths to remove the gamma heat more efficiently from the transducer coil), thereby considerably increasing the operational limit of these transducers. The analytical results and the experimental data have excellent correlation. The analytical approach has therefore been demonstrated and will be utilized to determine limitations on new designs. (auth)

10953 (WANL-TME-1196) NUCLEAR SAFETY EVALUATION OF NERVA REACTOR-IN-VESSEL SHIPPING CONTAINER. Vachon, L. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1965. 19p. Dep. NTIS $4.00.

The shipping container used for previous shipments of NERVA reactors has been modified for transport of NRX-A4 and subsequent reactors. These changes have been made to accommodate the reactor-in-vessel assembly which includes the shield assembly, pressure vessel, control actuator shafts and guide tubes in addition to the reactor subassembly. The adequacy of the original shipping container design was demonstrated during the shipment of NRX-A1, NRX-A2 and NRX-A3 and the same basic design criteria have been utilized in the modified container. The safeguards against accidental criticality that were incorporated in the original shipping container design have been retained. Furthermore, the requirements for Fissile Class III shipments have been satisfied. It is concluded that the modified shipping container will adequately protect the reactor against accidental criticality under all credible conditions. (auth)

10954 (WANL-TME-1210) NRX-A4/EST REACTOR ANALYSIS DATA. Wright, M. K. (ed.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Aug 1965. 394p. Dep. NTIS $22.75.

Declassified 30 Aug 1973.

Design analysis data for the NRX-A4/EST reactor is provided. The material includes reactor design goals, limitations, material temperature distribution, thermodynamic, and nuclear data. (auth)

10955 (WANL-TME-1212) NRX-A6 PRESENTATION, JUNE 29, 1965. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jul 1965. 56p. Dep. NTIS $6.00.

Declassified 11 Sep 1973.

10956 (WANL-TME-1253) NRX-A3 POSTMORTEM ANALYSIS. Persin, W.; Stancampiano, P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1965. 120p. Dep. NTIS $9.00.

Declassified 12 Sep 1973.

It can be concluded from the data that the radial and axial core expansions agreed well with calculations. The evaluation of tie rod strength after the high temperature excursion of the first power run indicated that the core axial support system was structurally sound. The measured tie rod loads agreed well with calculated values. In general, the core remained concentric throughout the test series. Control drum rubbing occurred at the start of the first power run but was relieved by the prechill in the second power run. There is no indication of excessively large motions or any serious threats to self-excited vibrations. Acceleration levels as high as three "g" at high frequencies were observed on certain pressure vessel accelerometers. These occur at transient conditions and are attributed in part to flow separations in the nozzle at these times. In general, the NRX-A3 reactor performed extremely well structurally and survived the flow tests, power test, and restart power test without serious mechanical damage. The following minor component damage occurred: a control drum housing weld failure; broken aft end lugs on two of the filler blocks; and cracks in the support blocks. (auth)

10957 (WANL-TME-1259) CLUSTERED NUCLEAR ENGINE STUDY POWER RANGE. Appendix. Analog Model of NERVA II Reactor for Power Range. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1965. 21p. Dep. NTIS $4.25.

Declassified 12 Sep 1973.

The model used for analog computer studies of clustered NERVA II reactors in the power range is described. Identical simulations of each reactor are coupled together through the reactor kinetics and detector models. The model of each reactor includes reactor thermal-hydraulics, coupled neutron kinetics, and the control system. The reactor thermal-hydraulics model includes the equations for heat transfer and propellant flow through the nozzle, reflector, tie tubes, and reactor core. The model is most accurate at the 100 percent design point and should not be used for quantitative answers below 10 percent power and 30 lb/sec flow. The coupled neutron kinetics model includes the reactivity feedback equation, the control drum reactivity equation, and the coupled kinetics equations. Like the sub-power range model, three delayed neutron groups are used. The neutron transport delay between reactors is neglected in the power range as the sub-power range study showed this effect to be negligible for the type of system being considered. The control system model includes equations for the control drum actuator, power controller, neutron detector, temperature controller, and thermocouple. The neutron detector simulation includes contributions from all reactors and uses the detector coupling coefficient used in the sub-power range study to determine the measured power level. All of the needed equations are given. (auth)

10958 (WANL-TME-1326) INVESTIGATION OF EFFLUENT SAMPLES FROM NRX-A3, EP V. Grandy, G. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Nov 1965. 42p. Dep. NTIS $5.25.

Declassified 11 Sep 1973.

Analyses of air samples are reported in connection with the NRX-A3, EP V test conducted on May 20, 1965, at the Nuclear Rocket Development Station (NRDS) in Nevada. The results are an indication of relative levels of airborne activity at ground level. The analysis is part of an effort to document the quantities of radioactivity released to the atmosphere during NRX and other reactor tests at NRDS. An evaluation of the technique used and recommendations for future studies is included. (auth)

10959 (WANL-TME-1333) POST-OPERATIONAL EXAMINATION OF NRX-A3 FUEL ELEMENTS. Simmons, C. R.; Jacobs, D.; Fiore, R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 209p. Dep. NTIS $13.50.

Declassified 11 Sep 1973.

After operation of the NRX-A3 reactor, the core was disassembled and the fuel elements visually examined and weighed. Selected fuel elements then received special examinations and/or tests related to: (a) the corrosion of the coolant channels, (b) flexure strength, (c) incremental electrical resistance, (d) incremental weight changes, (e) radiation effects, and (f) dimensional changes. Moderate surface corrosion, surface deposits of carbon and corrosion of the coolant channels were observed on all fuel elements. Frequently, pockets of corrosion within the coolant channels intersected the surfaces of the elements forming pinholes. Exposed coolant channels were observed, particularly on the coated ends of the elements. Occasionally, carbon deposition resulted in interelement bonding. The average weight loss of the fuel elements was obtained. The greatest contribution to weight loss was corrosion within the coolant channels. Changes in flexure strength and incremental electrical resistance, caused by corrosion and radiation effects, were observed. Axial dimensional changes were also noted. All of the above phenomena were analyzed with respect to their axial and radial distributions within the core and with respect to operational and material variables. (auth)

10960 (WANL-TME-1340) INSTALLATION HISTORY OF THE NRX-EST REACTOR INSTRUMENTATION. Swope, R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1965. 40p. Dep. NTIS $5.25.

Declassified 11 Sep 1973.

The installation of the instrumentation during the assembly of the NRX/EST reactor at the Westinghouse Astronuclear Laboratory (WANL) is described. The innovations and problem areas for each major subassembly of the reactor are discussed separately and in the proper sequence of construction. Improved methods and techniques of installation are being constantly developed and have been incorporated in the NRX/EST assembly. In addition, the present operation has served as a basis for improvements which are suggested for future reactors. (auth)

10961 (WANL-TME-1345) SURVEY OF POTENTIAL SHIELD MATERIALS. Poindexter, A.; Ricks, L.; Disney, R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1966. 121p. Dep. NTIS $9.25.

Declassified 11 Sep 1973.

Twenty-five shield materials for application in the NR-1 reactor have been evaluated from a shield weight, chemical, thermal, mechanical, and cost standpoint. Seven combinations of materials were found that appear to best satisfy these combined considerations for the NR-1 shield. Beryllium steel, a composite of TiH_2-B_4C-Al, and LiH-steel were selected as the best materials, each having its own advantages. It is recommended that the TiH_2-B_4C-Al composite be developed for the NR-1 flight shield, with the beryllium-steel as a prime backup; and LiH as a secondary backup. A fast, efficient, shield-weight optimization technique, containing a simplified physical description of the shield attenuation processes, is also described. (auth)

10962 (WANL-TME-1349) CRITICAL EXPERIMENTS IN SUPPORT OF NERVA. Quarterly Report, 1st Quarter CY'66. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Dec 1965. 64p. Dep. NTIS $6.25.

Declassified 11 Sep 1973.

PAX-D measurements in support of the NRX-A6 and the XE-1 were begun November 22, 1965, and continued throughout the quarter. The PAX-D assembly utilized in these experiments is

the same as the PAX-C reactor with the exception of the graphite inner reflector. The graphite reflector used in PAX-D mainly differs from previous PAX reactors by a removable 40° graphite sector and a redesigned lateral support mechanism. Initial criticality, drum worth and molybdenum reactivity coefficient measurements have been made. Experiments in support of the XE-1 included PNG shutdown measurements and detailed 1/M measurements. Other measurements in progress include a 30° NRX-A6 type reflector sector substitution and associated power distribution in this sector. Other facility tasks completed include installation of the PAX auxiliary shutdown system and enlargement of the fuel storage facilities in the test cell. (auth)

10963 (WANL-TME-1352) NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT CLEVELAND ON DECEMBER 9, 1965. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1965. 35p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

10964 (WANL-TME-1367) RESULTS OF A PRELIMINARY EXAMINATION OF THE HYDROGEN CORROSION BEHAVIOR OF NbC COATED HIGH EXPANSION GRAPHITES. Fleischer, L. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1966. 29p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

The hydrogen corrosion behavior of NbC-coated, commercial grades of high expansion graphite was surveyed. It was thought that the thermal expansion properties of these materials would allow the retention of a crack-free coating over a wide range of temperatures. It was hoped that by this means the corrosion through cracked coatings would be inhibited or eliminated. The preliminary results indicate no significant improvement in corrosion behavior with the use of high expansion graphite substrates. Further evaluation work on high expansion graphite substrates is recommended since the quality of the preliminary results do not justify the acceptance of this conclusion without reservation. (auth)

10965 (WANL-TME-1371) EVALUATION OF NRX-A3 POST-TEST FLEXURE STRENGTHS. Andersson, C. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 33p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

The post-test flexure results obtained on the NRX-A3 reactor fuel elements were analyzed in terms of three parameters known to produce significant effects on the flexure strength of NERVA fuel. Specifically, the effects of temperature, bore corrosion, and radiation damage were considered. "Out-of-reactor" studies of the effects of temperature and electrical corrosion test simulation on flexure strength were incorporated in the analysis. Qualitatively, the axial and radial variations of flexure strength observed for the NRX-A3 reactor were consistent with predictions. The importance of low power operation on the final strength condition of the fuel was clearly demonstrated from both the NRX-A3 results and the electrical test simulation studies. (auth)

10966 (WANL-TME-1401) NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT WANL ON FEBRUARY 25, 1966. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1966. 32p. Dep. NTIS $4.75.

Declassified 10 Sep 1973.

Development test results emphasized fuel element experiments and testing, but also involved tests of other reactor components, supports, springs, seals, etc. Friction and coating wear tests were made. (LTN)

10967 (WANL-TME-1402) PROGRESS REPORT ON THE EXPERIMENTAL INVESTIGATION OF FISSION PRODUCT DIFFUSION. Rymer, G. T.; Henninger, W. A.; Grandy, G. L.; Winnowski, W. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1966. 46p. Dep. NTIS $5.50.

Declassified 10 Sep 1973.

The effect of niobium carbide coatings on NERVA fuel elements on the release of fission products at different temperatures was investigated. In particular, the effects of sample size and metallic reactor components on the release of fission products at times and temperature corresponding to reactor accident conditions were examined. (LTN)

10968 (WANL-TME-1474) CRITICAL EXPERIMENTS IN SUPPORT OF NERVA QUARTERLY REPORT, 3rd quarter CY'66. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Jun 1966. 180p. Dep. NTIS $12.00.

Declassified 12 Sep 1973.

Critical experiments were performed on FCX and PAX-E mockups in support of NRX-A5, NRX-A6, and XE-PRIME reactors. The experiments involved initial criticality, reactivity coefficients, control rod worths, control instrument response, dosimetry, fat man worth, self-shielding, activation, etc. (LTN)

10969 (WANL-TME-1495) EXPERIMENTAL RESULTS OF THE NRX-A5 SINGLE SEAL PROGRAM. Steffen, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1966. 186p. Dep. NTIS $12.50.

Declassified 12 Sep 1973.

Flow-pressure drop data necessary for calculation of pressure loss coefficients has been obtained on a single seal segment simulating 1/12 of the NRX-A5 lateral support seal system. Tests were conducted at ambient temperature conditions with inlet hydrogen pressures of 500, 600, and 700 psig, and seal pressure differentials ranging from 0 to 50 psid. Configuration variables include filler strip gap, flow groove depth, number of scarf joints and scarf joint ramp clearance. Various leakage flows through the seal system were isolated by comparison of results from configurations without flow grooves, zero filler strip gap, and the addition of one extra scarf joint. These leakage flows are scarf joint leakage and interface leakage. The interface leakage is between the graphite to graphite interface, between the segment and filler strips, and the graphite to stainless steel interface between the seal segment and the reflector simulator. An additional series of flow visualization tests designed to show the major leak path through the total system is also reported. The results show that the major leak path was created by the square edge machined on the end of the scarf joint ramp. Hydrogen testing shows that machining the edge of the ramp to a knife edge reduces the scarf joint leakage by 50%. This series also demonstrated that better performance can be obtained from the joint if the engagement length is increased. Information of this nature is valuable in the design of core periphery seal systems where the leakage flow plays a vital part in the temperature distribution through the circumferential components of the reactor core. (auth)

10970 (WANL-TME-1511) SINGLE CLUSTER CORROSION TEST SUMMARY, APRIL 1966–SEPTEMBER 1966. Salvador, L. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1966. 78p. Dep. NTIS $7.00.

Declassified 10 Sep 1973.

Progress on the HHT-4 Cluster Corrosion Test is reviewed. The results of 12 high-temperature flow tests are presented. These tests were primarily proof tests and qualification tests of the NRX-A5 skirtless support block and XE-1 exit gas thermocouple configurations. In addition, developments in the state-of-the-art of high-temperature flow testing of clusters are reviewed. These include design modifications to upgrade the present configuration as well as a new cluster-lateral support model design. (auth)

10971 (WANL-TME-1532(Add.)) JOINT WANL/LASL/Y-12 FUEL AND REACTOR DEVELOPMENT REVIEW. Morris, W. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 24p. Dep. NTIS $4.25.

Declassified 10 Sep 1973.

A review meeting discussed fuel element development as follows: post-test observations of fuel elements and determination of weight losses, comparison of fuel elements from NRX-A4 and NRX-A5 reactors, densities, mechanical properties, thermal expansion, etc. (LTN)

10972 (WANL-TME-1606) MINUTES OF INSTRUMENTATION REVIEW MEETING AT SACRAMENTO ON MARCH 7-8, 1967. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Apr 1967. 215p. Dep. NTIS $13.75.

Declassified 10 Sep 1973.

A special furnace for developing, calibrating and qualifying temperature sensing devices in a simulated reactor environment is described. Temperatures up to 5000°R at working pressures up to 750 psi in hydrogen are available. The results of testing several thermocouples are given. Some attention is given to developments, requirements, and test results in strain gages, transducers, electrical insulation and displacement gages. (LTN)

10973 (WANL-TME-1613) NRX-A6 TEST PREDICTION REPORT. Knecht, W. L.; Rovnak, J. A. (eds.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1967. 138p. Dep. NTIS $10.00.

Declassified 10 Sep 1973.

Several preliminary tests and one reactor endurance test are planned on the NRX-A6 reactor at Test Cell "C" of the Nuclear Rocket Development Station in Nevada. These tests have been planned to provide significant development information on the design and operating performance of the test article assembly. Analytical predictions of the behavior of the test article during the planned tests are documented. These predictions will be

compared to test data during and after the test in order to establish whether the reactor performs in the expected manner. Included are predictions for normal operation and for emergency shutdown. (auth)

10974 (WANL-TME-1618) POST-OPERATIONAL EXAMINATION OF NRX-A5 FUEL ELEMENTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1967. 349p. Dep. NTIS $20.50.

Declassified 10 Sep 1973.

The post-operational examination of NRX-A5 fuel elements revealed that the principal effects produced during reactor testing were moderate to severe corrosion of surfaces and coolant channels which varied with core radius and manufacturing origin of the elements. As a result, the elements were known to have variably high to low weight loss, pinholing, coolant channel exposure, and corrosion weakening; this latter effect resulted in a high incidence of element fracture during disassembly. The relative magnitudes of corrosion effects observed for the NRX-A4 and NRX-A5 cores are given. (auth)

10975 (WANL-TME-1745) NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT WANL ON JANUARY 16, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 52p. Dep. NTIS $5.75.

Declassified 10 Sep 1973.

Test results in support of NRX-A6 and XE-2 reactor are reported, emphasizing fuel elements, seals, clusters, corrosion, welding, etc. (LTN)

10976 (WANL-TME-1781) WESTINGHOUSE ASTRONUCLEAR LABORATORY CONTRIBUTION TO THE TWENTY-SIXTH HIGH TEMPERATURE FUELS COMMITTEE MEETING, APRIL 30-MAY 1 AND 2, 1968. Fleischer, L. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1968. 16p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

The NRX-A6 reactor test demonstrated the capability of NERVA reactors to operate for 60 minutes at or above design conditions of 2050°C gas exit temperature and 1120 MW power. The key NRX-A6 nuclear and thermal parameters measured at full power agreed well with predictions. The reactivity loss from the NRX-A6 core during the 60 minutes of operation at full power was 65 c (compensated by a control drum rotation of 11 degrees), which was a great decrease in corrosion loss from the core in comparison with prior nuclear rocket tests. Post test examination of the corrosion of individual fuel elements confirmed the conclusion drawn in regard to the basis of reactivity loss: fuel element resistance to corrosion was superior. All of the NRX-A6 reactor test objectives were successfully accomplished. (auth)

10977 (WANL-TME-1788) ROVER PROGRAM REACTOR TESTS PERFORMANCE SUMMARY, NRX-A1 THROUGH NRX-A6. DeStefano, J.; Bahorich, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1968. 54p. Dep. NTIS $5.75.

A performance summary of the Rover Program is provided (NRX-A1 through NRX-A6 Reactor Tests). Also contained is a general description of these tests, and various operational performance data which will be useful for quick reference. A summary of performance data for the tests is presented, including time at or above various nozzle chamber temperatures and reactor thermal powers, maximum chamber temperatures and power and time at these temperatures and powers, integrated thermal power, equivalent rated power run times, and reactor reactivity losses. (auth)

10978 (WANL-TME-1798) NERVA ENGINEERING DATA AND DESIGN CONCEPTS. Volume I. Reactor Design Configuration. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Jun 1968. 223p. Dep. NTIS $14.25.

Declassified 11 Sep 1973.

The NERVA program has as its objective the development and qualification of a flight reactor with a nominal 1575-MW thermal power with a hydrogen propellant flow of 88.7 lbs./sec. to the thrust chamber at 4500°R and 450 psia. The design effort on the NERVA reactor has proceeded to a point in which tradeoff studies have been completed on a series of alternate designs on each of the components of the nuclear reactor. As part of these tradeoff studies, Mechanical, Structural, Thermal, Nuclear and Radiation Analysis of the candidate designs have been performed. These studies have resulted in a determination of the pros and cons of each of the design concepts, thus permitting a selection of a single recommended design in most cases. To support the planned Engineering Data and Design Concepts Meeting, a series of seven volumes has been prepared in addition to the Contract End Item (cei) and Engineering Critical Component (ecc) Specifications. (auth)

10979 (WANL-TME-1798(Vol. 2)) STRUCTURAL ANALYSIS. Volume II. Miller, D. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1968. 252p. Dep. NTIS $15.75.

Declassified 11 Sep 1973.

A discussion of the conceptual structural analysis of the NERVA Cluster Assembly and Miscellaneous Hardware (EC-677558) is presented, especially the central elements and the cluster forward end hardware, including the forward end secondary support systems. Two aft end configurations, bearing and standoff, are included. The reference design, with bearing aft end hardware, is shown in Drawing 939J519 and the alternate design, with standoff aft end hardware, is shown in Drawing 939J508. The effect on the fuel and central element stresses of the standoff design is shown. The fuel elements are nominally in compression. Their maximum stress is not increased by the change from a bearing design to a standoff design because the element which has the highest tensile stress is shorter and has never contacted the aft end hardware on any previous NRX designs. The central element has a nominal compressive stress of 2100 psi. This preliminary analysis yields a calculated axial stress in the central element during startup of 1200 psi, based on XE-1 thermal data. In the standoff design this stress will not be enough to overcome the compressive stress due to the cluster load in the central element. Based on some preliminary creep data, the central element would creep axially a maximum of 0.033 inches, and spread radially 0.0005 inch. These changes must be allowed for in the design. (auth)

10980 (WANL-TME-1805) XE-2 NUCLEAR SUBSYSTEM THERMAL AND NUCLEAR DESIGN DATA BOOK. Hill, D. J. (ed.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 399p. Dep. NTIS $23.00.

Declassified 11 Sep 1973.

The design analysis data from the Thermal and Nuclear Design Department for the XE-2 reactor is presented. The material includes reactor design goals, limitations, and nuclear, thermal, radiation, and corrosion data for the XE-2 reactor, divided into the following sections: Basic Design Requirements, Geometrical and Mass Data, Thermal Cycle Performance Data, Nuclear Data, Radiation and Shielding Data, Reflectors Thermal-Hydraulic Data, Shield Thermal-Hydraulic Data, Core Thermal-Hydraulic Data, and Corrosion Data. (auth)

10981 (WANL-TME-1815) EXPERIMENT DESIGN FOR GTR-20 RADIATION EFFECTS TEST OF BERYLLIUM, 37/W406. Burwell, D. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Jul 1968. 42p. Dep. NTIS $5.25.

Declassified 11 Sep 1973.

Beryllium has good neutron moderating and reflecting properties and has a low neutron absorption cross section. However, the NRX-A6 beryllium reflector exhibited extensive cracking, which is assumed to have occurred near the end of the run when the fast neutron fluence was approximately 3×10^{18} nvt. There is evidence of a synergistic effect between neutron fluence and applied load during irradiation for some materials. Therefore, a radiation effects experiment (GTR-20) is planned and is outlined in considerable detail, especially with respect to fracture toughness determinations after irradiations up to 1×10^{19} nvt and at 5 different temperatures. (LTN)

10982 (WANL-TME-1831) NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT WANL ON JULY 18, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1968. 63p. Dep. NTIS $6.25.

Declassified 11 Sep 1973.

Progress emphasized at the review meeting included: Thermal transient tests on beryllium neutron reflectors to make sure that the thin webs in some areas are not cracked by rapid temperature changes which induce large stresses in these areas; fuel element development, mechanical tests, corrosion tests, etc.; test facility modification and checkout; fuel element coatings and coating processes; support system tests (friction, thermal cycling, creep testing, wear, seals, etc.). Some poison wire development is mentioned (measurement of withdrawal force, ocean water corrosion of poison wires). (LTN)

10983 (WANL-TME-1839) NERVA REACTOR, TOPPING CYCLE STUDIES. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1968. 59p. Dep. NTIS $6.00.

Declassified 11 Sep 1973.

A feasibility study of the topping cycle and of the effect of the topping cycle concept upon the NERVA Reactor Design was proposed. The topping cycle consists of extraction of the full reactor flow from the reflector outlet plenum to drive the turbine and then returning this flow to the reactor into the central dome end plenum. It was suggested that this low temperature/high mass flow concept

has certain advantages to the engine system, such as higher engine I_{sp}, simplification of the nozzle design and elimination of the high temperature piping (and need for insulation thereof) between the nozzle and the turbine. The hot bleed cycle consists of a high temperature/low mass flow bleed from the nozzle chamber to the turbine with the flow re-entering the cycle aft of the nozzle throat. The NRX technology reactors and the R/E reactor design have been based upon the hot bleed cycle which has been successfully demonstrated by the NRX/EST test. The design and analysis work on the adaptation of the Topping Cycle into the NERVA reactors has been conceptual in nature and thus reflects limited depth of evaluation. However, the study indicates that the topping cycle is technically feasible. Component design changes will be required in a number of areas along with several newly designed components. (auth)

10984 (WANL-TME-1861) NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT WANL ON SEPTEMBER 26, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1968. 49p. Dep. NTIS $5.50.

Declassified 11 Sep 1973.

The development review meeting was devoted mainly to the development and testing of fuel elements, and reactor core periphery areas (wrappers, (including corrosion and axial flow impedance), supports, etc.). High temperature friction and creep measurements were also made on graphite support items and tensile properties were measured on others. Several other items are mentioned briefly. (LTN)

10985 (WANL-TME-1867) SUMMARY FABRICATION REPORT FOR THE NERVA XE-2 FUELED ELEMENTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 Oct 1968. 20p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

The fabrication of XE-2 was performed with the identical processes developed in the previously successful effort of the NRX-A6 core. The routine manner in which the XE-2 core was fabricated demonstrates the performance improvement obtainable for NERVA reactors when manufacturing variables are stabilized and production problems minimized. (auth)

10986 (WANL-TME-1896) FISSION PRODUCT RELEASE FROM NERVA FUELS. A Summary. Henninger, W. A.; Roesmer, J.; Rymer, G. T. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1969. 91p. Dep. NTIS $7.75.

Declassified 12 Sep 1973.

Attendant to high temperature operation of a gas cooled reactor with unclad fuel elements is the release of radioactive fission products. In order to determine the magnitude of the release of these fission products, a fission product diffusion program was initiated in 1962. Experimental methods utilized in the fission product diffusion program involved solid state diffusion studies on the release of fission products from various types of NERVA fuel as a function of time and temperature. Also the quantity of fission products released during the various reactor tests made by WANL at the Nevada Test Site was determined. Diffusion constants derived from fission product release rates obtained in the laboratory were used as input to a computer code, FIPDIF, which was developed to estimate the magnitude of fission product release during NERVA reactor tests. Measurements of the actual fission product release during tests were used to evaluate the accuracy of the calculations. The measured values of fission products released during a test were also used to modify the input to the code. Thus, via an iterative process the accuracy of the predictions was improved. The significant results of laboratory experiments on fission product diffusion reported previously are also summarized. (auth)

10987 (WANL-TME-1918) PAX-G1 REACTIVITY EFFECT MEASUREMENTS. Final Test Report. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1970. 61p. Dep. NTIS $6.25.

Declassified 12 Sep 1973.

Two sets of reactivity measurements were made in the PAX-G1A reactor containing nuclear mockups of R-1 reactor components in order to verify analytical methods and to provide data for normalization of R-1 reactor predictions. The first of these measurements, a determination of the reactivity coefficient of "Q" material (zirconium), indicated a discrepancy between calculation and experiment. Accordingly, a study is underway to re-evaluate zirconium cross sections as well as the calculational model used to represent the experiment. The second set of measurements involved determination of the reactivity worth as a function of radius for a group of mockup support stem assemblies. For this set of measurements, the predictions were in excellent agreement with the experimental measurements. (auth)

10988 (WANL-TME-1932) VIEWGRAPH PRESENTATION ON STATUS OF NERVA FUEL ELEMENT ELECTRICAL TESTING. Guzek, J. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Jun 1969. 33p. Dep. NTIS $4.75.

Declassified 12 Sep 1973.

The status of corrosion testing of NERVA fuel elements is reviewed. Electrical test capabilities are described in which direct current is utilized to resistance heat the element to reactor temperature levels and with comparable reactor hydrogen flows. The corrosion test is one of the major tools used in the development of NERVA fuel and a number of studies have reported on the electrical, thermal, and hydraulic characteristics. The technique of heating is different from the reactor and as such, interpretation is required to discern reactor capability. Significant modifications which have been made to the furnace since the first NERVA reactor (NRX-A2) effort are described and have produced noteworthy comparisons between electrical test and reactor corrosion data. Meaningful comparisons of fuel element corrosions have been obtained in preparation for the NRX-A6 reactor as well as from NRX-A6 post test evaluation. A continuing program of furnace development and understanding is indicated to accommodate a trend of extended fuel element requirements and characteristics. (auth)

10989 (WANL-TME-2681) NERVA INTERNAL SHIELD DESIGN CONCEPTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1970. 377p. Dep. NTIS $22.00.

Declassified 10 Sep 1973.

A Trade Study of design concepts for the Internal Shield, a component of the NERVA Nuclear Subsystem, is presented, NSS. The purpose is to evaluate and select the most logical and reasonable approach for continued detail design and development of this component consistent with the programmatic and technical requirements for the 10 hour full flow cycle engine as defined in the NERVA Program Requirements Document. The evaluation and selection is based on the construction of a comparison matrix. Each concept is evaluated against the requirements and the tentative selection is based on an objective approach which identifies the concept having the maximum likelihood of meeting the functional, technical and programmatic requirements. The BATH Shield is the concept selected and recommended for continued detail design and development. The major factors leading to this selection are described. (auth)

10990 (WANL-TME-2698) R-1 FUEL MATERIAL DEVELOPMENT. Final Report. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1970. 35p. Dep. NTIS $4.75.

Declassified 10 Sep 1973.

The development and testing of a coated, intermediate expansion, fuel element made from Great Lakes Flour is documented. An evaluation of the flour is presented and properties data are given for non-fueled and 500 mg/cc loaded elements. The fueled elements were coated with a number of different NbC-ZrC coating combinations and then corrosion tested. Corrosion test data are summarized in tables and the detailed data on coating runs and corrosion tests are appended. (auth)

10991 (WANL-TME-2707) NSS RADIAL DIMENSION OPTIMIZATION STUDY. Weisensee, D. K. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1970. 90p. Dep. NTIS $7.50.

Declassified 11 Sep 1973.

A trade study of parameters affecting the outside radial dimension of the reflector assembly, a component of the NERVA Nuclear Subsystem (NSS), is presented. The purpose is to provide justification of the parameters affecting the radial dimension and to determine the most logical and reasonable combination of component radial dimensions to minimize the reflector assembly outside dimension. The evaluation and selection of the radial dimension is based upon a computerized design technique. This design technique was developed with the objective of maximum utilization of previous design studies and independent engineering studies of individual components while also accounting for the dependence between the various design parameters. The optimized, or minimum, reflector assembly outside radial dimension recommended is 54.00 inches. The factors leading to this selection are described. (auth)

10992 (WANL-TME-2728) OUTGASSING AND VAPORIZATION EFFECT OF PYROFOIL LAYERS BONDED WITH PETROLATUM. Final Report. Davidson, A. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1970. 25p. Dep. NTIS $4.25.

Declassified 11 Sep 1973.

The outgassing and vaporization effects under rapid heat up transients are experimentally investigated for multiple layers

of pyrofoil bonded with petrolatum. Both thermalized rerolled pyrofoil (PDS 30141-1) and unthermalized pyrofoil (PDS 30182-2) are included. The pyrofoil layers are shaped to stimulate their application in the peripheral region of the R-1 reactor. Maximum heat up temperature ramps at 75° per second are applied to the layers until a hot side temperature of 2500° is attained. An overtest at a heat up ramp of 100°R per second and a hot side temperature of 5600°R are also evaluated. These two sets of temperature conditions bracket the maximum conditions anticipated for pyrofoil usage in the R-1, 10 hour 60 cycle reactor. Visual observations show that the vaporization and outgassing produce some blistering of the pyrofoil surfaces and some positive net dimensional expansion. Analysis of these effects shows that petrolatum bonded pyrofoil layers are satisfactory for use in the R-1 reactor. (auth)

10993 (WANL-TME-2735) CORE PERIPHERY MODEL TEST 64DT-212. Final Report. Karp, G. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1970. 156p. Dep. NTIS $11.00.

Declassified 11 Sep 1973.

On the basis of core periphery model tests, the following conclusions have been reached: The wrapper design concept (full length pyrofoil wrapper) tested does not have the requisite 10 hour lifetime. It did, however, demonstrate the original planned 80 minute capability. Larger leakage flow through the wrapper occurred than was expected as evidenced by wrapper corrosion damage. From an inspection of the wrapper O. D., it was observed that no measurable corrosion damage occurred in regions exposed to temperatures less than approximately 2400°R. The observed corrosion damage was not analytically predicted with the present modelling of the corrosion phenomenon. Pyrofoil corrosion reaction rates at least ten times greater than those based on previous test data are required to calculate comparable damage. No significant corrosion occurred on the radial faces of the simulated fuel elements giving possible evidence of the presence of helium in the interelement gaps. Differences between the calculated model pressure drop and the measured value can be partially explained by leakage flow through the wrapper. Wrapper strain capability was demonstrated to be adequate. Slippage occurred between pyrofoil layers, relieving wrapper strain. No wrapper tears were observed during post-test inspection. (auth)

10994 (WANL-TME-2736) FIVE INCH AXIAL LENGTH CORE PERIPHERY EVALUATION MODEL. Final Report. Cooper, L. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1970. 60p. Dep. NTIS $6.00.

Declassified 11 Sep 1973.

A series of hydraulic bundling, thermalizing, and depressurization tests was conducted on a short (5 inch long) model of the 64DT-031 Cyclic Strain Test to investigate the large pyrofoil expansion experienced at the relatively cool forward end of that test. These tests are used to verify corrective measures proposed for subsequent 64DT-211 and 212, "Corrosion Tests" to prevent excessive pyrofoil expansion. Hydraulic bundling tests utilizing internal and external differential pressures on the pyrofoil wrapper have negligible effect on the wrapper growth. Thermalizing a pyrofoil wrapper in the test fixture results in less than 1.7% wrapper growth. Depressurization tests at reactor depressurization rates of 50 psi/sec cause a Petrolatum bonded unthermalized pyrofoil wrapper to grow 26% while thermalized pyrofoil wrappers with and without Petrolatum bonding grow only 4% to 6%. It is concluded that thermalized pyrofoil assembled with or without Petrolatum would be acceptable for use in the 64DT-211 and 212 Corrosion Tests at nominal depressurization rates of 50 psi/sec. (auth)

10995 (WANL-TME-2738) PERIPHERY AXIAL LOAD TEST. Final Report. Davidson, A. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1970. 98p. Dep. NTIS $8.00.

Declassified 11 Sep 1973.

An evaluation of structural load tests of primary and secondary support load paths of periphery filler strips and axial support hanger assemblies for the R-1, 10 hour reactor is presented. A total of 62 axial load tests are evaluated. The tests represent variations in configuration and material for six different failure modes. The significant conclusion of the test data and the analysis is that the 939J806 filler strip and hanger assembly design will sustain reactor axial loads if the peripheral fuel to insulation interface coefficient of friction is below .20. (auth)

10996 (WANL-TME-2742) CORE PERIPHERY MODEL, TEST 64DT-211. Final Report. Karp, G. S. (ed.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1970. 77p. Dep. NTIS $7.00.

Declassified 11 Sep 1973.

The cyclic corrosion resistance capability of an R-1 type periphery featuring a multiple layer Z-liner thermalized rerolled pyrofoil wrapper was experimentally measured. This test employed an SX-5 graphite core and simulated fuel elements. These materials simulate the growth characteristics of the high expansion fuel proposed for the R-1 design. The results obtained in this test are similar to those obtained in the 64DT-212 test with the thermalized wrapper thermalized in-place. This test further substantiates the low probability for this full length wrapper concept to achieve the R-1, 10-hour lifetime requirement. Good agreement was realized between the measured test data and the predicted thermal/hydraulic conditions. Corrosion damage to the pyrofoil wrapper appears to originate largely in the butt joints between adjacent Z-liners. This indicates significant amounts of hydrogen leakage through these joints and higher corrosion rates for pyrofoil than had been expected prior to the 64DT-211 and 64DT-212 tests. Examination of the wrapper O. D. shows that no measurable corrosion damage occurred at temperatures below 2400°R. (auth)

10997 (WANL-TME-2745) EVALUATION OF NSS DESIGN-MISSION INTERACTIONS. Stumpf, H. J.; Black, D. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1971. 31p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

Several analyses were made to evaluate the interaction of NSS design and mission requirements. These studies were related to the effect of cooldown temperature and throttling on propellant use, the endurance and comparative cost of operation of the three primary fuel element candidates, and the reactivity loss due to fuel burnup and fission product poisoning. (auth)

10998 (WANL-TMI-1902) PRELIMINARY SUMMARY OF THE PEWEE I MANUFACTURING CAMPAIGN. Birge, J. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Apr 1968. 23p. Dep. NTIS $4.25.

Declassified 10 Sep 1973.

The Pewee I core parts supplied by WNCO and WEFF differ due to a combination of variables such as fuel loading, flow channel diameter, impregnated and additive element matrices, composite tips, and new and/or different protective coating processes. The fabrication of the various parts was essentially normal with respect to previous successful efforts except for noticeable tooling wear associated with machining the harder composite materials, minor process control difficulties inherent in the new coating processes, and some resultant fuel element coating characteristics which required reworking and/or variation request actions for acceptance to the core. (auth)

10999 (WANL-TNR-006) NERVA REACTOR SUPPORT INFORMATION FOR E-MAD FACILITY. Phase I. NERVA Nuclear Subsystem. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1962. 45p. Dep. NTIS $5.25.

Declassified 10 Sep 1973.

The facility study was made to provide the requirements and conceptual design of the E-MAD facility at Jackass Flats, Nevada, for the NERVA rocket engine testing support, with provisions for handling components of larger engines. The conceptual design chosen will provide for a complete facility for the assembly of the engines and reactors, disassembly of fired engines as received from the static test stands, maintenance of the reactors and engines either before or after test firing, and post-operational examinations and testing of reactor and engine components. Sufficient flexibility has been incorporated in the design to permit future expansion. (auth)

11000 (WANL-TNR-027) NERVA DESIGN REQUIREMENTS. Phase I. NERVA Nuclear Subsystem. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1962. 22p. Dep. NTIS $4.25.

Declassified 10 Sep 1973.

The Westinghouse responsibility in the NERVA program is, in part, modification of the KIWI reactor designs to enable them to meet environmental, safety and reliability requirements for the NERVA engine. The basic approach is to redesign those components which do not meet the flight engine needs from these standpoints. The environmental requirements are the principal aspects of this discussion. The adequacy of each component must be established with regard to the loads induced by shipment, ground handling, static test and booster operation. These loads and other conditions are presented. In addition, startup, steady state operation, shutdown, decay heating and cooling and restart must be considered for NERVA operation. The adequacy of each component must be determined with regard to stress, strain, buckling, fracture, fatigue, creep and relaxation, as well as chemical attack and the effects of irradiation. Design criteria

are developed to aid in the computation of component stresses and allowable stress levels. (auth)

11001 (WANL-TNR-038) TRANSIENT REACTOR EXPERIMENTS ON NERVA FUEL MATERIAL. NERVA Nuclear Subsystem. Boltax, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1962. 52p. Dep. NTIS $5.75.

Declassified 10 Sep 1973.

The principal conclusion reached is that uncoated sections of off-the-shelf KIWI B-4 fuel material will fragment when pulsed with a nuclear transient of the order of 200 MW, in the TREAT reactor. An equivalent pulse can be delivered in the nuclear rocket by a transient of the order of 5000 MW. Fragmentation initiated by the transient gives rise to the formation of particles less than approximately $\frac{1}{8}$ inch in diameter. Theoretical consideration of the mechanisms of fragmentation of KIWI B-4 fuel material indicates that the most probable mechanism of fragmentation of the off-the-shelf fuel (partially hydrolyzed) is due to internal pressure buildup from either reaction between UO_2 and carbon or the decomposition of the products of the hydrolysis reaction. Both the results of electric heating experiment performed at LASL and the present results obtained in the transient experiments are consistent with the proposed mechanism. Fission product release accompanying the fragmentation of the fuel gives rise to loss in activity of from 30 to 60 per cent. The fission product release is greater for the large particles than the smaller particles, presumably because of the slower cooling rate of the large particles. Transient reactor experiments offer a means of obtaining basic information on the behavior of NERVA fuel material. (auth)

11002 (WANL-TNR-039) RE-ENTRY AND BURNUP OF REACTOR FRAGMENTS. NERVA nuclear subsystem. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1962. 78p. Dep. NTIS $7.00.

Declassified 10 Sep 1973.

Analytical and experimental programs have been carried out on unfueled graphite materials with the object of determining mass loss rates due to oxidation during re-entry. From the results obtained, an attempt was made to predict the maximum size of graphite particles which would be reduced to a 25 micron diameter before reaching an altitude of 100,000 feet. This particle size would then be assigned as the necessary maximum particle size for any type of destruct mechanism which is designed to eliminate the radiation hazard from re-entering nuclear reactor parts. (auth)

11003 (WANL-TNR-040) SURVEY OF FISSION PRODUCT RELEASE FROM NERVA FUEL MATERIAL. NERVA Nuclear Subsystem. (Westinghouse Electric Corp., Cheswick, Pa. (USA)). Mar 1962. 42p. Dep. NTIS $5.50.

Declassified 10 Sep 1973.

The primary purpose of the present work is to consider the problem of fission product release from an intact core during a decay heat cycle. This is part of the over-all safety and hazards analysis of the NERVA program. In particular, the results of a literature review of fission product release from fueled graphite are described and the problem of planning an experimental program which would provide the kind of fission product release data required in several phases of the NERVA program is considered. (auth)

11004 (WANL-TNR-046) REACTOR AND SHIELD MECHANICAL DESIGN, Phase I, NERVA Nuclear Subsystem. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1962. 350p. Dep. NTIS $20.50.

Declassified 10 Sep 1973.

NERVA Phase I design was directed toward establishing environmental, safety and reliability criteria for a flight type reactor, analyzing LASL KIWI B-2 reactor designs for application to space flight and preparing preliminary redesign of components as required by the analysis. Reflector, shield and interface requirements are treated in detail. In addition, the requirements and design of the E-MAD facility for cold assembly and hot disassembly of nuclear engines are discussed. (LTN)

11005 (WANL-TNR-047) REACTOR AND SHIELD ANALYSIS, NERVA PHASE I ACTIVITY. NERVA Nuclear Subsystem. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1962. 410p. Dep. NTIS $23.50.

Declassified 10 Sep 1973.

Shield nuclear and thermal design data, and radiation environment data generated during Phase I of the NERVA Contract are described. The shield nuclear analyses include definitions of the radiation environment around a shielded and unshielded core, propellant tank heating for shielded and unshielded conditions, and a vehicle optimization study for determining the minimum weight of the vehicle system required to limit propellant heating to an acceptable level. The thermal analyses were carried out for both the heated bleed and the hot bleed cycles. Various heat exchanger shield design configurations were investigated and are included. (auth)

11006 (WANL-TNR-057) METHOD OF STATISTICAL ANALYSIS OF THE EFFECTS OF MANUFACTURING TOLERANCES AND OTHER DEVIATIONS ON OPERATING TEMPERATURES OF THE NERVA B-4 CORE. Thomas, G. R.; Nelson, P. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1962. 60p. Dep. NTIS $6.00.

Declassified 10 Sep 1973.

The effects of various physical deviations within the NERVA B-4 core are calculated and the results in terms of increased fuel operating temperatures are discussed. A statistical treatment of these variations is made and a degree-of-risk curve is plotted versus fuel operating temperature. The statistical method is also compared with the method of cumulative hot channel factor products. (auth)

11007 (WANL-TNR-058) RADIATION ENVIRONMENT AROUND THE NERVA ENGINE WITH NRX-A REACTOR. Capo, M. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Jun 1962. 59p. Dep. NTIS $5.50.

Declassified 10 Sep 1973.

An analysis of the radiation environment around the NERVA engine with an NRX-A reactor is presented. The NRX-A is defined here as the KIWI B-4 core assembly supported from the top aluminum support plate by means of metal tie rods and unfueled graphite bottom support blocks. It also incorporates a lithium-hydride-stainless steel shield. The system is enclosed in a titanium pressure vessel. The actuators and actuator shafts, the turbopump, the gimbal and the tank shut-off valve were also included in the study. Shielding computer program 14-0 was used to calculate the gamma ray energy flux and dose rate, and fast neutron ($0.01\ \text{MeV} \leq E$) flux and dose rate at fifteen different azimuthal angle positions around the NRX-A at distances of 5, 10, 15, 20, and 30 feet from the center of the reactor core. A one-dimensional multigroup P-1 code, "P1MG", was used to obtain the thermal neutron and fast neutron ($E \leq 0.01$ MeV) flux along the core center line axially at the top and bottom, and radially on the line of symmetry. These data are presented in both tabular and graphical form. (auth)

11008 (WANL-TNR-066) SLIDES USED AT TECHNICAL PROGRAM REVIEW. NERVA Nuclear Subsystem. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 19 Jul 1962. 129p. Dep. NTIS $9.50.

Declassified 10 Sep 1973.

11009 (WANL-TNR-076) NERVA NUCLEAR SUBSYSTEM COVERING THE PERIOD CONTRACT YEAR 1962 (JANUARY 11, 1962–SEPTEMBER 30, 1962). Summary Report. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Nov 1962. 252p. Dep. NTIS $15.75.

Declassified 10 Sep 1973.

The KIWI B-4 reactor was chosen as the basis for NRX-A, the prototype NERVA reactor, and modified to meet the expected radial and longitudinal loadings. In addition, a number of detail design changes have been incorporated in NRX-A as the result of thermal, fluid flow, nuclear, and dynamic analysis and component testing. A lithium hydride-steel-boron-hydrogen radiation shield for use in the KIWI B-5 test was designed and followed through fabrication. An NRX-A shield design was begun based on this concept. It was modified as necessary to reflect the engine cycle change from heated to hot bleed. Beaded fuel (UC_2 particles coated with pyrolytic carbon in a graphite matrix) was chosen for the NRX-A reactors because of its resistance to hydrolysis on air storage. Mechanical tests have been performed to establish component behavior in the areas of core support, seals, control drum bearings, shield components, friction coefficients, and engine vibration. The primary thermal and fluid flow analysis effort has been devoted to establishing the adequacy of the NRX-A reactor and KIWI B-5 shield designs in steady state and under transient conditions. Analytical methods have been developed as necessary to deal with these problems. Flow test models have been constructed. Cooldown analyses have been performed for flight engines and reactors on test. The nuclear design of NRX-A has been directed to establishing the uranium loading, control, and power distribution. Poison wire systems were studied for auxiliary control during reactor handling. An engine reactor control system specification has been prepared and updated. Analog analysis has established a number of characteristics and features of this system, and has been applied to studying the effects of component malfunctions. Candidate and prototype control system components have been procured and subjected to laboratory and irradiation testing. The Astrofuel

Facility for production of NERVA fuel was completed, and the fabrication process developed by pilot runs and material tests. The process steps and quality assurance procedures to be used in NRX-A fuel production have been defined. Overall test plans and procedural documents for the NRX-A test series were issued. Irradiation test programs were surveyed, consolidated, and redirected to the use of the Plum Brook and Fort Worth reactor facilities. Facility modifications were designed for the Plum Brook Facility. (auth)

11010 (WANL-TNR-081) FAILURE MODE ANALYSIS SUMMARY. NERVA Control Drum Actuator Proposed By General Electric (model AG-14). Spezialetti, I. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jan 1963. 41p. Dep. NTIS $5.25.

Declassified 10 Sep 1973.

A failure mode analysis of the NERVA pneumatic control drum actuator design proposed by General Electric (Model AG-14) has been made. The results are summarized with emphasis on the recommendations of design changes to improve the over-all reliability of the actuator. (auth)

11011 (WANL-TNR-082) FAILURE MODE ANALYSIS SUMMARY. NERVA Control Drum Actuator Proposed By Bendix (Model ND-D1). Spezialetti, I. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jan 1963. 60p. Dep. NTIS $6.00.

Declassified 10 Sep 1973.

A failure mode analysis of the NERVA electropneumatic control drum actuator design (Bendix Model ND-D1) has been made. The results are summarized with emphasis on the recommendations of design changes to improve the over-all reliability of the actuator. (auth)

11012 (WANL-TNR-087) REACTOR ASSEMBLIES FOR NON NUCLEAR TEST SYSTEMS (SIMULATORS). Fundesen, C.; Crews, R.; Kaisner, R.; Kim, C.; Pierce, B.; Thompson, D. C.; Thomas, G. R.; Vetere, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Jan 1963. 79p. Dep. NTIS $7.00.

Declassified 10 Sep 1973.

Non-nuclear test assemblies are exact duplicates of a reactor except for the core section, where either non-fueled or depleted fuel graphite is used. The primary objective is to duplicate and study the interaction, displacement, vibratory motions, and stress of reactor components under the flow and thermal conditions of the reactor startup transient. They are also useful for checking flow interaction between engine and test facility, checking installation details and instrumentation and control system performance. (auth)

11013 (WANL-TNR-097(Rev.1)) NRX-A1 TEST PLAN. Revision 1. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1963. 141p. Dep. NTIS $10.25.

Declassified 10 Sep 1973.

The NRX-A1 flow tests will permit an evaluation of the mechanical integrity, fluid flow and thermal aspects of the reactor (NRX-A1 is unfueled but otherwise identical to NRX-A2). The major objectives of the NRX-A1 test program are: To assess the mechanical stability of the reactor under various flow conditions with both gas and liquid feeds; to determine the temperature and pressure distributions in the reactor under the various flow conditions and to evaluate insofar as possible, the amount of leakage and bypass flow from temperature and pressure measurements in the seal area; and to establish the environmental conditions in the reactor with various flow conditions. The tests will simulate certain reactor run conditions, such as startup, cooldown, etc. The proposed tests are described in detail. (auth)

11014 (WANL-TNR-104) COMPARATIVE EVALUATION OF PNEUMATIC ACTUATORS FOR THE NERVA REACTOR. Hornberger, D. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Apr 1963. 181p. Dep. NTIS $12.25.

Declassified 9 Jun 1966.

The test results and operating experience with the Bendix and General Electric actuators have been sufficient to indicate the performance, life, reliability, and potential capability of each concept. The conclusion drawn from the Bendix testing is that reasonable performance compared with the specification can be attained, but the short operating life of both the components and the actuator would impair the operation and subsequent reliability of the engine. In contrast, the General Electric actuator has shown good performance over a considerable operating range with long life and superior reliability. The areas requiring improvement are not detrimental to the operation, and these changes will be incorporated in the next generation of actuators. It is, therefore, recommended that the General Electric actuator be selected to operate the control drums for the NERVA engine. And in addition, that the next generation specification be issued as soon as possible in order to meet the E-1 engine schedule. (auth)

11015 (WANL-TNR-114) STUDY OF FUEL ADDITIVES FOR ENHANCEMENT OF FLIGHT SAFETY. Phase I. Initial Screening Studies. Feild, A. L. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2[illegible] Jun 1963. 101p. Dep. NTIS $8.25.

Declassified 10 Sep 1973.

An experimental program was conducted to determine effects of high melting point integral additives on the oxidation behavior and mechanical properties of unfueled and fueled NERVA reactor core materials. Mechanical property tests were conducted from room temperature to 4000°F and oxidation tests at 2200°F. A total of seventeen additives were investigated, comprising the carbides, nitrides, borides, and silicides of the refractory and reactive metals. Rhenium metal was also studied. Additives in amounts of 1 w/o and 5 w/o were incorporated in graphite matrix materials using the standard NERVA fuel element production procedures. Oxidation tests were conducted in a special flow system which simulated a high altitude re-entry trajectory point. Mechanical property tests consisted of tensile and flexural strength measurements carried out in argon or vacuum in suitable test facilities. It was concluded that the most promising additives studied (WC, Mo_2C, VC, and Re) are capable of doubling the oxidation rate of unfueled and fueled NERVA core material with optimum concentrations. All additives increase the mechanical strength of normally processed core material over a wide temperature range if present in the optimum percentage. However, molybdenum carbide and rhenium were the only additives that appeared to increase the strength of fueled materials over the entire temperature range as measured by tensile and flexure tests. Sensitization (heating to 5000°F) produces significant lowering of mechanical strength of fueled and unfueled materials. Sensitization tends either to increase or decrease oxidation rates in fueled and unfueled materials, depending on the contained additive. (auth)

11016 (WANL-TNR-115A) ASSEMBLY PROCEDURES NRX-A1. Revision A. Aducci, S. A.; Moritz, W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1963. 145p. Dep. NTIS $10.25.

Declassified 10 Sep 1973.

The procedures to be followed and the equipment to be used in assembling the NRX-A1 are described. The sequence of operations to be followed during assembly is listed and additional documentation and other relevant supplementary information required are identified. (auth)

11017 (WANL-TNR-116) NRX-A SHIPPING CONTAINER DESIGN REPORT. Ulrich, J. M.; Kraus, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1963. 111p. Dep. NTIS $8.75.

Declassified 10 Sep 1973.

Shipping container design is the technology of preparing an item for shipment in such a manner as to eliminate damage from the environmental conditions encountered during shipment. The problem of developing a shipping container for the NRX-A reactors is discussed. The formulation of the design criteria and the special requirements developed for the container were based on design parameters defined for the reactor, Westinghouse experimental data, analysis, engineering judgment and current literature. The design, fabrication and testing of the initial container was performed by the Applied Design Company, Tonawanda, New York, working in conjunction with and under the technical direction of the Westinghouse Astronuclear Laboratory (WANL). In a series of tests conducted by Applied Design and WANL, it was shown that the container fully satisfies all the design criteria and special requirements. (auth)

11018 (WANL-TNR-120) ASSEMBLY PROCEDURES NRX-A2. Zwillich, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1963. 147p. Dep. NTIS $10.50.

Declassified 10 Sep 1973.

The procedures to be followed and the equipment to be used in assembling the NRX-A2 are described. The sequence of operations to be followed during assembly is listed and additional documentation and other relevant supplementary information required is identified. (auth)

11019 (WANL-TNR-139) IRRADIATION STUDIES ON NERVA FUEL MATERIAL. Contract Year 1963. Vogel, M. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Sep 1963. 34p. Dep. NTIS $4.75.

Declassified 10 Sep 1973.

Studies of the irradiation behavior of NERVA fuel material are being conducted in steady-state and transient irradiations

in the General Electric Testing Reactor (GETR) and in the Transient Test Reactor (TREAT), respectively. The evaluation of NERVA fuel at equivalent full power operation (2-4 kW/cc) requires thermal neutron fluxes of $3\text{-}6 \times 10^{14} n/cm^2 \times sec$ for times up to 30 minutes. This combination of flux and time is not available in existing irradiation facilities. The reactors used for the program bracket the two requirements. The GETR provides the required time and 20% of the neutron flux requirement, TREAT provides the neutron flux for periods up to 15 seconds. GETR can be used to obtain preliminary steady-state, high-temperature fuel material behavior with respect to fission product release, dimensional stability and fuel migration. On the other hand, TREAT is useful to study the effects of thermal stress on fueled graphite matrix behavior. The preliminary studies indicate that irradiation-enhanced uranium migration may occur in 15 minutes at 1800°C. However, further work is required before definitive conclusions may be drawn relative to fuel particle behavior. (auth)

11020 (WANL-TNR-145) TEST REPORT ON A WANL RADIATION TEST OF NERVA COMPONENTS (GTR TEST NUMBER FOUR). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Nov 1963. 51p. Dep. NTIS $5.75.

Declassified 10 Sep 1973.

GTR-4 was the first NERVA radiation effects test conducted in the Ground Test Reactor at the Nuclear Aerospace Research Facility (NARF) of General Dynamics/Fort Worth. Instrumentation and instrument components (neutron detectors, pulse preamplifiers, accelerometers, resistance thermometers, strain gages, pressure transducers, bearings, resistors, capacitors, coaxial cables, triaxial cables) were irradiated at liquid nitrogen temperatures (14°R) at first and then, following two detonations, cooled less efficiently by gaseous nitrogen (310°R to 635°R). The exposures were (1.5–30) 10^{16} nvt and (2.4–24) 10^{19} erg/g (c) gamma. Detailed results of the exposure on the various instruments are given. Many instruments failed, but due to the force of the detonations, debris, and the heat during the latter part of the exposure, it is difficult to determine the precise cause of failure. Some instruments survived with negligible change. (LTN)

11021 (WANL-TNR-157) TRANSIENT IRRADIATION EXPERIMENTS ON NERVA FUEL MATERIAL. Simmons, C. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1963. 74p. Dep. NTIS $6.75.

Declassified 10 Sep 1973.

NbC coated fueled graphite (containing pyrocarbon coated UC_2 particles) was tested under nuclear transient conditions in TREAT. Information was obtained on structural integrity, fission product release and general fuel material behavior at sample transient energies of 5580 calories per gram, peak sample temperatures greater than 3500°C and reactor periods as low as 39 milliseconds. (auth)

11022 (WANL-TNR-176) NERVA PROGRAM. NRX-A1 Test. Final Report. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1964. 257p. Dep. NTIS $16.00.

Declassified 11 Sep 1973.

A major aspect of the NRX-A1 test series was to determine the ability of the reactor mechanical design to overcome damaging core vibrations observed in early KIWI testing. After a critical review of all available information, the conclusion was reached that there was no evidence of large, low frequency vibrations either forced or self-excited which would imply dynamic instability in the test assembly. The test series was run on the NRX-A1 reactor which contains an unfueled core, mechanically equivalent to future NRX-A reactors containing nuclear fuel. Although power was not generated during the NRX-A1 test, the flow path was identical to future power tests. The flow enters the plenum beneath the outer reflector from the nozzle tubes, continues up the outer reflector, then through the simulated shield, turns, passes through the core, and discharges out the nozzle. Parallel flow paths cool the pressure vessel, dome, graphite reflector cylinder, lateral support parts, and the aluminum barrel surrounding the graphite reflector. Various thermal and fluid flow aspects of future testing were simulated during the NRX-A1 test series, including test assembly environmental conditions encountered during a portion of the nuclear startup transient; simulation of core and reflector pressure drop expected during NRX-A2 testing and simulation of reflector pressure drop conditions encountered during emergency cooldown of a hot reactor. No major thermal or flow problems were observed during these simulations. Higher core pressure drop than originally calculated was observed. This was caused by choked flow conditions in the fuel element jet orifices which was not taken into account in the original calculations. This occurrence does not affect full power nuclear operation, since choked flow occurs only during the initial portion of the nuclear startup transient. (auth)

11023 (WANL-TNR-184) THERMAL STRESS EXPERIMENTS ON NERVA FUEL MATERIAL. Vogel, M. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1964. 25p. Dep. NTIS $4.25.

Declassified 11 Sep 1973.

NERVA reactor fuel material operates at relatively high power densities of 2-4 Kw/cm^3. Under normal operation this level of heat generation leads to relatively modest stress levels of the order of 500 psi. However, abnormal operating conditions may be caused by plugged coolant channels or hydrogen in-leakage at the core periphery. Both of these conditions would serve to increase local temperature differences and, thus, local stress levels. Under these conditions stress levels up to 2000 psi have been estimated. In order to investigate both normal and abnormal core behavior, thermal stress experiments were performed by pulsed nuclear heating in the transient reactor test facility (TREAT). Two types of nuclear pulses were utilized to mockup, respectively normal and abnormal core thermal conditions, namely slow or extended nuclear pulses and fast nuclear pulses. The work completed in TREAT indicates that as-manufactured (virgin) NERVA fuel material will suffer no damage from the normal operational steady-state or cyclic thermal stresses. In addition, the fuel material can withstand thermal stress levels above 1800 psi produced by radial temperature differences up to 1520°C/inch which might result from plugged core channels, peripheral fuel element power peaking and/or cold hydrogen in-leakage. (auth)

11024 (WANL-TNR-199(Suppl.1)) ANALYSIS OF NRX-A2 REACTOR TEST RESULTS. Boman, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1965. 110p. Dep. NTIS $8.50.

Declassified 12 Sep 1973.

The results of an analysis and diagnosis of experimental data from the NRX-A2 test and comparisons of the data with calculations were given in the parent report (WANL-TNR-199). In order to gain the full benefits of the test and advance the technology, it is necessary to resolve all differences between calculation and experiment. Included in this supplement are extended analyses to verify reactor flow distribution, core material temperatures and lateral support temperatures. Additional investigation of critical control drum position and feedback reactivity anomalies are also included. NRX-A2 test results have been used to improve the Reactor Model for transient analysis. A description of this model is given. Analyses of post-operational data have been completed since WANL-TNR-199 was published and are presented. These include an analysis of graphite corrosion and comparison to post-operative measurements and extended post-operative fission distribution results. Additional Low Power Mapping Test temperature data is also included. (auth)

11025 (WANL-TNR-210) NRX-A3 FINAL REPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1965. 65p. Dep. NTIS $6.25.

Declassified 5 Sep 1973.

The NRX-A3 test series comprised seven experimental plans (EP's), which were intended to bring the NRX-A3 in a series of low-flow, low-power tests to a full design power test. During EP-IV, after 3.5 minutes of full power (1120 megawatt) operation, an unplanned, automatic shutdown occurred, which resulted in overheating of the core tie rod assembly. It is believed that a loose electrical connection in the turbine overspeed circuit was the cause of this shutdown. A comprehensive review of all the test data indicated that the reactor was not damaged, and a decision was made to continue the tests with a full power restart. During EP-V, the reactor was operated for 16 minutes, 13.1 minutes of which were at full power. The total integrated operating times for EP-IV and EP-V was 22 minutes, with 16.6 minutes at full power. The specific impulse achieved at the full power hold was approximately 750 seconds, corrected to vacuum conditions, while the calculated thrust was 53,400 pounds. The reactor was started a third time during EP-VI primarily for medium power mapping and controls tests. A significant feature of these tests was a fixed control drum position test in which the reactor power was controlled with the propellant flow rate only. The results were in excellent agreement with the predictions. This test showed definitely that the reactor is inherently stable on liquid hydrogen flow control only, which is a major step in the simplification of controls for future NERVA systems. Post-test disassembly and examinations confirmed analyses that the core structural system had not been damaged by the full-power shutdown transients, and that the restarts had not jeopardized reactor integrity or safety. Analyses of the fuel material pointed up specific areas where additional design work and future development should be emphasized in order to achieve the eventual core lifetime necessary to meet future objectives. In summary, the reactor system as a whole performed extremely well. In addition,

the experimental data agreed with analytical predictions so well that confidence in predicting the behavior of NERVA systems over wide ranges of operating conditions has been increased appreciably. (auth)

11026 (WANL-TNR-224) NRX-A6 FINAL REPORT. DeStefano, J. (ed.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 190p. Dep. NTIS $12.50.

Declassified 10 Sep 1973.

The results of the NRX-A6 test demonstrated the endurance capability of the NRX-A6 reactor at rated conditions. The combination of improved fuel element coating techniques, across flats dimensional control, attention to coefficient of thermal expansion, flattened core power distribution, and changes in core interstitial pressure distribution resulted in marked improvements in core corrosion performance. Fuel bore corrosion improvement efforts, primarily in the mid-band region have resulted in elements capable of 60 minute one-cycle operation at exit gas temperatures up to 4440°R with weight losses of approximately 13 grams. Comparison of NRX-A6 Quality Control corrosion test data and subsequent parametric corrosion tests of NRX-A6 elements indicated reasonably successful correlation of corrosion test results with reactor results. Further, the corrosion test results indicated that at NRX conditions, two and perhaps more cycles could be tolerated for 60 minutes operating time. Several other items contributing to the success of this test are discussed. (auth)

11027 MARINE ENGINES. Geisler, O.; Gietzelt, M. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Schiffsmaschinen und Dampfkessel). VDI (Ver. Dtsch. Ing.) Z.; 116: No. 18, 1493-1500(Dec 1974). (In German).

Following a general introduction into the state of development in the field of marine engines, diesel motors, gas turbines, steam turbines, and nuclear power plants are described. The work is based on an extensive bibliography. (GE)

11028 WHAT ABOUT NUCLEAR SHIPS. Wilhelmsen, J. Jr. (Norges Skipsforskningsinstitutt, Oslo). NSFI (Nor. Skipaforsk. Inst.) Nytt; 3: No. 1, 12(Apr 1974). (In Norwegian).

The recent steep rise in oil prices and difficulties in obtaining bunker oil have revived interest in 10-year old nuclear ship projects. According to the conclusions reached then nuclear power would become competitive with a bunker oil price of n.kr. 200/tonne. This level has been exceeded now. However, the political situation makes any normal consideration of resources, supply, and demand in making a prognosis impossible. The quoted price of n.kr. 200/tonne assumed that all other charges remained unchanged. In the past 10 years prices have generally doubled and a new analysis of the whole situation would be necessary, especially of the cost of reactor and fuel. While the number of large ships potentially suitable for nuclear propulsion is larger than 10 years ago, the situation regarding third party responsibility and insurance and port permits is not yet clear. The recruiting and training of personnel is another problem. A delay of 10 years before a general utilization of nuclear propulsion must be reckoned with. However, production of ship reactors has previously been said to be well suited for Norwegian industry. (NO)

11029 NUCLEAR MERCHANT SHIPS. Washington, DC; National Academy of Sciences (1974). 137p. $6.75.

Questions concerning U. S. strategy with respect to the development of nuclear-powered merchant ships are examined. Aspects covered include foreign trade, comparative costs, price and availability of oil, health and safety, environmental considerations, and trade route alternators. (JWR)

Reactor Safety and Environmental Aspects

Refer also to abstracts 8607, 8957, 8961, 8964, 8967, 9195, 11118, and 11125.

11030 (AED-CONF-75-003-001) PRELIMINARY RESULTS OF INVESTIGATIONS ON THE DYNAMIC BEHAVIOR OF THE CONTAINMENT FOR THE BRUNSBUETTEL NUCLEAR POWER PLANT DURING BLOWDOWN. Appelt, K. D.; Cramer, M.; Eberle, F.; Goeller, B.; Kadlec, J.; Laursen, B. M.; Schlechtendahl, E. G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). 1975. 3p. (In German). INIS.

From special meeting on thermo and fluid dynamic problems related to reactor incidents; Stuttgart, F. R. Germany (28 Jan 1975).

Measurements were carried out at the Brunsbuettel reactor in order to determine the pressure pulsation field induced in the condensation chamber during blowdown and the corresponding dynamic response of the containment. This system response was accurately calculated. Eigenfrequencies and natural shapes of oscillation of the Brunsbuettel safety container were calculated for this purpose with the ICES-subsystem DYNAL. (GE)

11031 (AGC-2316) OPERATIONAL SAFETY EVALUATION OF ETS-1 COMPLEX. (Aerojet-General Corp., Sacramento, Calif. (USA)). 31 Oct 1962. 268p. Dep. NTIS $16.50.

Declassified 10 Sep 1973.

An initial review and evaluation of the safety aspects associated with the first nuclear-rocket engine tests at Engine Test Stand No. 1 located at the Nuclear Rocket Development Station in Nevada is presented. Current descriptions of the test site, the test stand facility, and the NERVA Engine are provided. Discussion includes the hazards associated with normal operations and those resulting from the more probable, or serious, facility or engine malfunctions. Where deficiencies in the design or operating procedures exist, either from the standpoint of personnel safety or system integrity, remedial action has been indicated or further study recommended. (auth)

11032 (AGC-2421) RIFT SAFETY REVIEW PROGRAM, NERVA SYSTEMS DESCRIPTION. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1963. 273p. Dep. NTIS $16.75.

Declassified 11 Sep 1973.

Current design information and operating characteristics for the NERVA engine and its components are provided. The data are for use by the various contractors, sub-contractors, and government agencies associated with the RIFT Program in performing a series of comprehensive safety evaluations and reviews of the NERVA engine in relationship to its intended flight operations. (auth)

11033 (BNWL-SA-5423) IMPACT OF INSERVICE INSPECTION ON THE RELIABILITY OF PRESSURE VESSELS AND PIPING. Bush, S. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 23p. (CONF-750617-14). Dep. NTIS $4.25.

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

The reliability of pressure components of a nuclear reactor is a function of the quality as-fabricated plus a program of continuing inspection during operation. Since insufficient data exist to quantitatively determine failure probabilities of nuclear pressure vessels and piping, it is necessary to utilize information from comparable non-nuclear systems such as power boilers. Based on probabilistic studies it is inferred that in-service inspection improves component reliability one-to-two orders of magnitude depending on the type and completeness of the inspections. An attempt is made to assess the significance of the ASME Section XI Code as to relative completeness of inspection and the probable improvement in reliability. (auth)

11034 (CEA-CONF-2843) ANALYSIS OF THE SEISMIC BEHAVIOR OF NUCLEAR REACTOR STRUCTURES. Calculation Methods. Experimental Methods. Jeanpierre, F.; Livolant, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). 1974. 33p. (In French). INIS.

From colloquium on the methods for shock study and simulation; Lyon, France (16 Oct 1974).

The present state of earthquake analysis methods in the nuclear field is summed up. Protection against earthquakes may be of an economic or safety type. In the former case it must be proved that in the event of an earthquake the plant can continue to operate, in the latter that if a serious earthquake occurs the safety of populations and personnel is guaranteed. On the geological side, accelerogram data obtained for recent earthquakes are available. It is shown that statistical forecasting of possible earthquakes at a given site must be improved, and that more detailed research is necessary on the relationship magnitude-oscillator spectrum shape and the influence of the soil type. On the structural analysis side the major effort is devoted to the study of damping and non-linear behavior of structures under strong deformations. (FR)

11035 (CENPD-128) VESSEL ENTRY TESTS. Task C. Steam–Water Interaction Tests. Loiselle, V.; Brodrick, J. (Combustion Engineering, Inc., Windsor, Conn. (USA). Nuclear Power Dept.). Feb 1974. Contract AT(11-1)-2244. 34p. Dep. NTIS $4.75.

Tests are reported which were performed to investigate the time required for ECCS water to reach the reactor vessel lower plenum following LOCA. The vessel entry tests showed reasonable repeatability for the six tests performed. The injection water transit time, from the injection section to the bottom of the core barrel in the reactor vessel, decreased as the ECC flow increased for both the saturated temperature wall tests (200°F) and the superheated temperature wall tests (300°F). The transit times for the saturated

temperatures wall tests ranged from 2.56 seconds to 4.68 seconds. The transit times for the superheated temperature wall tests ranged from 1.88 seconds to 5.96 seconds. (auth)

11036 (CENPD-129) COLD LEG CONDENSATION TESTS. Task C. Steam–Water Interaction Tests. Brodrick, J. R.; Loiselle, V. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Mar 1974. Contract AT(11-1)-2244. 108p. Dep. NTIS $8.50.

A report is presented of tests to determine the condensation efficiency of ECC water injected into a quality fluid mixture flowing through the cold leg. In particular, a specific objective was to determine if the mixture of ECC water and quality fluid reached thermodynamic equilibrium before exiting the cold leg. Further, the stability of the ECC water/quality fluid interaction would be assessed by interpretation of thermocouple records and utilization of a section of cold leg piping with view ports to film the interaction whenever possible. The cold leg condensation tests showed complete condensation of the 5 lbm/sec steam quality mixtures in the cold leg by the ECC water flows of the test matrix. The cold leg exit fluid temperature remained below the saturation temperature and had good agreement with the predicted cold leg outlet temperature, calculated assuming total condensation. (auth)

11037 (CENPD-181) ATWS: IMPROVED SHUTDOWN SYSTEM FOR ANTICIPATED TRANSIENTS WITHOUT SCRAM. Class A Plants. Herbst, J. J. (Combustion Engineering, Inc., Windsor, Conn. (USA)). May 1975. 98p. Combustion Engineers, Inc., Windsor, CT.

This topical report describes an improved reactor shutdown system which Combustion Engineering is proposing to meet the Class A plant ATWS requirements of Section II.A of Appendix A of WASH-1270. The significant features of this improved shutdown system are: (1) Diverse trip channels for selected trip parameters; (2) Solid state circuitry which permits automatic on-line testing of protection system circuitry from (but not including) sensors to the reactor trip switchgear; (3) Diverse means of interrupting power to the Control Element Drive Mechanisms (CEDM's); and (4) On-line testing of the CEDM's. Diversity in selected trip channels and diverse power interrupt devices for the CEDM's assure that common mode failures in the shutdown system sensors or trip switchgear will not prevent a scram in response to an anticipated transient. Testing of the shutdown system circuitry and CEDM's increases the reliability of the shutdown system such that the ATWS safety objective is met and all requirements of WASH-1270 are satisfied. (auth)

11038 (CONF-750527-1) APPLICATIONS OF UNDERSTANDING OF TRANSIENT FUEL FAILURE MECHANISMS IN DESIGN AND LICENSING OF LMFBRs. Deitrich, L. W. (Argonne National Lab., Ill. (USA)). 1975. 15p. Dep. NTIS $4.00.

From international working group on fuel failure mechanisms; Seattle, Washington, USA (11 May 1975).

Some applications of fuel failure technology in reactor design and licensing efforts are discussed. Topics covered include failures in transient overpower accidents, failures in loss-of-flow accidents, off-normal transients, and applications to inherently safe fuel design. (JWR)

11039 (CONF-750527-3) EXPERIMENTS ON TRANSIENT FUEL FAILURE MECHANISMS: SELECTED ANL PROGRAMS. Deitrich, L. W. (Argonne National Lab., Ill. (USA)). 1975. 51p. Dep. NTIS $5.75.

From international working group on fuel failure mechanisms; Seattle, Washington, USA (11 May 1975).

Some of the experimental work related to understanding of fuel failure mechanisms under transient conditions performed at Argonne National Laboratory is reviewed in this paper. Both in-reactor and laboratory tests are considered. The range of tests discussed includes measurements of fuel properties needed in analytical work, laboratory studies of the response of fuel subjected to temperature transients by direct-electrical-heating (DEH) techniques, and laboratory experiments on cladding failure under transient heating conditions. In-reactor tests conducted in TREAT are also discussed, including the E- and H-series transient overpower accident simulations, the L- and R-series loss-of-flow accident simulations. In addition to completed tests, needs for future experiments directed at model verification and integral tests of failure threshold are discussed. This testing is directly applicable to development and verification of analytic models of fuel behavior and of fuel pin failure. Larger scale tests are also reviewed as these experiments provide the ultimate test of the ability of predictive techniques to represent events in a realistically sized pin bundle. (auth)

11040 (CONF-750624-2) TEMPERATURE NOISE MEASUREMENTS IN BLOCKED AND UNBLOCKED 19-PIN ELECTRICALLY HEATED LMFBR FUEL SUBASSEMBLY MOCKUPS. Fry, D. N. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Sodium temperature noise was measured at the exit of a simulated fast reactor fuel subassembly to determine the feasibility of using temperature noise monitors to detect flow blockages in fast reactors, a matter of ever-increasing concern in the LMFBR program. Noise from both blocked and unblocked test bundles was characterized using various noise signal descriptors such as power spectral density, cross spectral density, amplitude probability distribution, and root mean square (rms). The results indicate that it might be possible to detect blockages in LMFBR's by monitoring the noise from subassembly exit thermocouples. (auth)

11041 (EPRI-294-2) MIXING OF EMERGENCY CORE COOLING WATER WITH STEAM: 1/14-SCALE TESTING PHASE. Lilly, G. P.; Stephens, A. G.; Hochreiter, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jan 1975. 330p. NTIS $9.50.

For Electric Power Research Inst., Palo Alto, CA.

During a postulated Loss of Coolant Accident (LOCA) for a Pressurized Water Reactor, the primary coolant system is calculated to void rapidly, resulting in core drying out and overheating. At the end of the blowdown phase of the accident the safety injection pumps and the passive accumulators begin to refill and reflood the vessel to cool the core. During the early stages of core reflood, the core-generated steam mixes with the accumulator water which is injected into the cold leg piping. This mixing process results in a pressure drop in the cold leg, which influences the venting capability of the core. Sensitivity studies have been performed on the effects of increasing and decreasing the cold leg resistance due to the steam/water mixing process. If, as a base case, the cold leg is assumed to be completely plugged (IAC assumption), unplugging the cold leg will result in a 25-50°F peak clad-temperature reduction for 90° cold leg injection. The magnitude of the benefit is dependent upon the containment pressure and the duration of the accumulator injection. The higher the back pressure and the longer the accumulation injection period, the larger the peak clad-temperature reduction. For angled injection, the peak clad-temperature benefit was larger (50-100°F) since the cold leg resistance was either zero or negative due to the pumping action of the injected water. A steam/water mixing program to analyze the mixing behavior in the cold leg is described. (auth)

11042 (GA-A-13325) BACK-PRESSURE REQUIREMENT FOR CACS CORE COOLING. Malek, G. J.; Petersen, J. F.; Roberts, D. L.; Jones, H. (General Atomic Co., San Diego, Calif. (USA)). 7 Mar 1975. 77p. (GA-LTR-19). General Atomic.

A licensing topical report is presented to establish the minimum containment equilibrium back-pressure requirement in a standard 2000/3000 MW(t) HTGR for the core auxiliary cooling system (CACS) to perform a safe plant cooldown following a design basis depressurization accident (DBDA). The supporting analysis and data for CACS performance and those components which govern the acceptability of the postulated accident transient are presented. (auth)

11043 (GEAP-12519) OXYGEN THRESHOLDS FOR THE SODIUM-FUEL REACTION; AN EVALUATION OF EXPERIMENTAL AND THEORETICAL RESULTS. Adamson, M. G. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jul 1974. Contract AT(04-3)-893. 36p. AT.

The equilibrium oxygen concentration (C_O^{eq}) in sodium for the three-phase system $\langle Na \rangle + \langle Na_3U_{1-y}Pu_yO_4 \rangle + \langle U_{1-y}Pu_yO_{2-x} \rangle$ at temperatures between 600 and 900°C is important for predicting the extent of coolant-fuel chemical interaction, and concomitant fuel rod swelling, in defected Liquid Metal Fast Breeder Reactor (LMFBR) fuel rods. If C_O^{eq} were to exceed the normal oxygen level in large sodium loops (0.5 to 1.0 ppM) the amount a defected rod could swell would be limited solely by the amount of available oxygen in the fuel; however, if $C_O^{eq} < 0.5$ ppM the amount of oxygen available for reaction/swelling at the defect zone could be essentially unlimited. In this report, attempts to measure C_O^{eq} and ΔG_O^{-eq} (the corresponding equilibrium oxygen potential) are first described then evaluated by comparison with "theoretical" values calculated using assessed thermodynamic property data for reactants and products in the sodium + fuel reaction. It is concluded that the low C_O^{eq} results derived using the vanadium wire equilibration technique are suspect. Based on a combination of EMF cell results and thermochemical calculations, the current preferred values of C_O^{eq} appropriate to the temperature range 600 to 750°C are 1.0 ± 0.4 and $1.5^{+1.5}_{-0.5}$ ppM. At this level, failed LMFBR-type mixed oxide fuel pins could continue to operate in

large sodium loops without undergoing additional severe swelling provided the coolant oxygen level remains at 0.5 to 1.0 ppM. (auth)

11044 (GEAP-13317-09) BWR BLOWDOWN HEAT TRANSFER, NINTH QUARTERLY PROGRESS REPORT, JULY 1–SEPTEMBER 30, 1974. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Oct 1974. Contract AT(04-3)-189. 88p. Dep. NTIS $4.00.

Three additional 49-rod bundle blowdown heat transfer (BDHT) matrix tests have been completed. Evaluation of the scaling basis BDHT test has been completed and data are presented. Data from the reference test are compared to key parameter predictions. Effects of parameter variations are examined. (auth)

11045 (GEAP-13923-10) SAFETY ENGINEERING. Tenth Quarterly Report, November–December 1974 and January 1975. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Feb 1975. Contract AT(04-3)-893. 42p. AT.

The objective of the work reported under this program is to provide an independent evaluation of existing experimental data and analytical models relating to design and safety analysis of LMFBR cores, and to identify requirements for additional model development and testing in support of long-term LMFBR safety evaluations. Progress during November and December 1974 and January 1975 is described. (auth)

11046 (INIS-mf-1700, pp 22-25) SAFETY CRITERIA FOR CONTAINMENT DESIGN. Kriz, Z. (Ceskoslovenska Komise pro Atomovou Energii, Prague). 1974. (In Czech).

In nuclear heating and containment. Supplement.

A list is given of general safety criteria relating to a nuclear power facility, i.e., the criteria that must be observed for all constructions, systems, and components important for the safety of a nuclear power plant as a whole. Particular attention is paid to safety criteria for various containment systems. The requirements for a containment system are discussed, such as tightness, the safeguarding of the containment integrity, the feasibility of pressure tests, a regular inspection of important components, the coolant system, and the fission products monitoring system. (INIS)

11047 (INIS-mf-1700, pp 46-54) QUANTITATIVE COMPARISON OF CONTAINMENT: BUILDINGS FOR PWR. Heitsch, M.; Mueller, R.; Kubis, K.; Thaele, R.; Uhlmann, G. (Technische Univ., Dresden). 1974.

In nuclear heating and containment. Supplement.

Safety and costs of full pressure containments and pressure suppression containments are compared. The ice condenser containment system and iodine removal in this type of containment are discussed in more detail. (INIS)

11048 (IRS-S-11) ARGUMENTS AGAINST NUCLEAR ENERGY–ARE THEY VALID. Comments on an Interview with Professor K. Bechert. Franzen, L. F.; Jacob, P. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Nov 1974. 39p. (In German). INIS.

The curriculum of the "well-known" nuclear energy critic Prof. Bechert is briefly given, his publications are compiled, and his arguments against nuclear energy in the WDR TV interview in the fall 1973 with its problems are put right. (GE)

11049 (IRS-W-11(2-75)) DESIGN OF NUCLEAR PLANTS AGAINST EXTERNAL EFFECTS. Fragments from an Airplane Accident. Intermediate Report. Drittler, K.; Gruner, P.; Suetterlin, L. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Feb 1975. 45p. (In English and German). Dep. NTIS (US Sales Only) $5.25.

The case of an airplane engine which impacts upon a structural part is discussed. Considerations concerning the probability for such an event are followed by estimations of the impact velocity of an engine which has been torn-off a fast flying military airplane during an accident. The penetration depths for concrete material and the protection thicknesses are determined. The load function resulting from impact of the engine upon a rigid wall is presented and variations of this function which may be caused by penetration effects are discussed. Finally, an example is presented showing that properly dimensioned structural parts are quite capable of withstanding the loads which result from impacting airplane engines. (auth)

11050 (IRS-W-12(3-75)) DESIGN OF NUCLEAR PLANTS AGAINST EXTERNAL EFFECTS. Partial Aspect: Considerations on the Risk in Airplane Accident on a Nuclear Power Plant. Intermediate Report. Suetterlin, L. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Mar 1975. 31p. (In German). Dep. NTIS (US Sales Only) $4.75.

The risk of operating a nuclear power plant that is not protected against an airplane crash is analyzed. Considerations of probabilities are made and numerical data for various categories of air traffic are given. A general consideration of the possible extent of damage after an airplane impact upon an unprotected nuclear power plant is followed by a discussion of the risk philosophy which is based upon the Farmer-diagrams. Furthermore the facts are specified which led to the decision that nuclear power plants in the Federal Republic of Germany must be protected against an airplane crash. (7 references) (auth)

11051 (NEDO-20626-1) STUDIES OF BWR DESIGNS FOR MITIGATION OF ANTICIPATED TRANSIENTS WITHOUT SCRAMS, Amendment 1. Claassen, L. B.; Eckert, E. C. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Jun 1975. 12p.

Supplementary information is provided in response to questions concerning GE BWR system operating conditions and equipment performance characteristics as related to anticipated transients without scram. (DG)

11052 (ORNL-NSIC-55(Vol.4)) DESIGN DATA AND SAFETY FEATURES OF COMMERCIAL NUCLEAR POWER PLANTS, Vol. IV. Dockets 50-452 Through 50-503. Heddleson, F. A. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 159p. Dep. NTIS $15.00.

Design data, safety features, and site characteristics are summarized for 36 nuclear power units in 18 power stations in the United States. Six pages of data are presented for each plant consisting of thermal-hydraulic and nuclear factors, containment features, emergency-core-cooling systems, site features, circulating water system data, and miscellaneous factors. An aerial perspective is also presented for each plant. The volume covers reactors with dockets 50-452 through 50-503. (auth)

11053 (SD-71-466-8(Vol. 6)(Ph. 3)) NUCLEAR FLIGHT SYSTEM DEFINITION STUDY. Phase III. Final Report. Volume VI. Reliability and Safety Analysis. Lane, A. G. (North American Rockwell Corp., Downey, Calif. (USA). Space Div.). Apr 1971. 109p. Dep. NTIS $8.50.

The Reusable Nuclear Shuttle (RNS) Phase III reliability and safety effort is oriented to an analysis of the major subsystems down to the major component level for the selected baseline design configuration, i.e., a single tank conical configuration with an aft bulkhead geometry employing an eight-degree half cone-angle and a 25-inch end cap radius. Reliability logic diagrams are developed for the major subsystems based, wherever possible, upon the criteria of (1) fail operation/fail safe for mechanical components and subsystems; and (2) fail operational/fail operational/fail safe for electrical components and subsystems. A failure mode effects and criticality analysis (FMECA) for the major subsystems is then presented in terms of the three criticality categories utilized in the Phase II analysis. The effects of maintenance on cumulative mission reliability are discussed in terms of the basic NR approach to RNS maintainability. This approach generally consists of replenishment or removal and replacement types of operations. The safety implications of both nuclear and non-nuclear hazards from launch operations through flight operations is presented for the reference lunar mission. Primary emphasis is placed on flight safety requirements associated with orbital assembly, normal mission operations, maintenance and repair, NERVA engine disposal and mission abort operations. Radiation levels from both natural radiation from the space environment and NERVA engine operation are investigated in the establishment of the aforementioned reference mission safety requirements and in the assessment of potentially hazardous operations. The preliminary fault tree analysis (FTA) derived in Phase II was revised to reflect the Phase III reference vehicle configuration. Identification is expanded at least to the major component level based upon the level of detail incorporated in the design of specific major subsystems. The FTA's complemented by the FMEGA's and reliability logic diagrams are used to determine the sequence of failures leading to an undesired event with potential safety hazards, i.e., those events relating to (1) earth population safety and (2) space crew safety. (auth)

11054 (TID-26815) WREM: WATER REACTOR EVALUATION MODEL. (USAEC Regulatory Staff, Washington, D. C.). Oct 1974. 226p. Dep. NTIS $14.50.

The Water Reactor Evaluation Model (WREM) consists of several computer programs developed to evaluate the consequence of a light-water-cooled power reactor when subjected to a postulated loss-of-coolant accident (LOCA) with emergency-core-coolant injection. The WREM computer programs are almost entirely in FORTRAN IV and are programmed for the IBM digital computers. The analytical techniques and assumptions used in the WREM computer programs are in accordance with 10 CFR Part 50 Appendix

K–ECCS, WREM codes were developed based on existing computer programs modified to comply with the acceptance criteria. The purpose of this document is to provide general descriptions of the analytical models added or modified to make existing computer programs conform to the Commission Criteria, and to provide the user with sufficient information to use the Evaluation Model programs. (auth)

11055 (TID-26816) WATER REACTOR EVALUATION MODEL (WREM): PWR NODALIZATION AND SENSITIVITY STUDIES. (USAEC Regulatory Staff, Washington, D. C.). Oct 1974. 179p. Dep. NTIS $12.00.

The Water Reactor Evaluation Model (WREM) consists of several computer programs developed to evaluate light-water-cooled power reactor transient response to a postulated loss-of-coolant accident (LOCA). Results of the sensitivity studies performed on the PWR evaluation model are presented. The sensitivity studies performed were to study the analytical model associated with the WREM computer code package, and to perform audit calculations. (auth)

11056 (UJV–3165-R) RELIABILITY ANALYSES OF THE CORE OF A FAST REACTOR ON THE BASIS OF THE HYPOTHESIS OF A MAXIMUM PERMISSIBLE NUMBER OF FAILURES. Pecha, P. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Oct 1974. 32p. (In Czech). Dep. NTIS (US Sales Only) $4.75.

A method of reliability analysis based on the assumption of a maximum permissible number of failures (hot channels or cladding and fuel hot spots) in the reactor core is described. Uncertainties affecting thermal hydraulic design are distinguished as local or global in nature in their application. Reliability assessment of the core design against over-temperatures is then introduced by two different criteria in dependence on knowledge of the frequency function of the failures. Both methods were applied to the hypothetical fast reactor core and a quantitative comparison is performed between these methods and others used formerly for thermal hydraulic design of nuclear reactor cores. (auth)

11057 (WANL-TME-1448) STUDY OF LAND AREAS CONTAMINATED FROM A SUBORBITAL EXPLOSIVE DESTRUCT OF A NERVA ENGINE. Bridges, J. M.; Brown, W. S.; Hargrove, H. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Jun 1966. 120p. Dep. NTIS $9.00.

Declassified 10 Sep 1973.

Explosive destruct has received much attention as a potential countermeasure to prevent, or substantially reduce, the amount of radioactive debris deposited on inhabited land masses following failure of a nuclear rocket engine. The most serious shortcoming in any objective study on the merit of destruct has been the lack of experimental data. However, with the successful completion of the destruct test on a full scale, simulated Nerva reactor at the Aberdeen Proving Ground (APG) in 1965, usable information has become available. The development of an analytical procedure for determining both the amount and dispersal patterns of radioactive debris on the Earth's surface by combining the APG destruct data with various re-entry and geometrical techniques is described. Next, the development of a screening study utilizing this analytical procedure is discussed. The principal objective was to determine the effect of gross changes in reactor attitude, failure time, and destruct initiation time on the amount of radioactive debris deposited on the African continent following a failure of the engine during sub-orbital flight. (auth)

11058 (WANL-TME-1533) EFFECT OF NERVA ENGINE ATTITUDE ON THE RE-ENTRY OF DESTRUCT DEBRIS. Hargrove, H. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Oct 1966. 36p. Dep. NTIS $5.00.

Declassified 10 Sep 1973.

A study has been made to determine the allowable variation in attitude of a failed nuclear rocket such that destruct action will prevent radioactive debris from impacting with the African continent. The failure time span of interest is that segment of the nuclear powered suborbital flight of a 72 hour lunar transfer mission for which the absence of an active countermeasure will lead to African impact of the reactor. The destruct action is assumed to be identical with that obtained from tests in a reference destruct system. The results obtained indicate that with proper attitude control, utilization of destruct can prevent, for a limited time, the contamination of the African continent. However, because the attitude-fail time envelope rapidly diminishes with increasing rocket operating time, it was ascertained that the reference destruct system was incapable of preventing impact of radioactive debris on Africa throughout the entire failure time span of interest for the mission involved. (auth)

11059 (WANL-TME-957) ANALYSIS OF THE EFFECT OF POST-OPERATIONAL HEAT ON A NERVA REACTOR. Trammell, M. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Oct 1964. 86p. Dep. NTIS $7.50.

Declassified 10 Sep 1973.

A computer program, NOFLOW, has been developed to predict the range of temperatures attained in a NERVA type reactor for those cases in which no post-operational cooling is used. Data for a variety of operating times prior to shutdown and a variety of shutdown schedules were obtained. An analysis of these data indicates that a number of conclusions can be drawn. Loss of coolant at shutdown always involves some loss of fuel due to sublimation. All cases examined indicate that tie-rod melting occurs within, at most, 30 seconds after shutdown. No structural damage is to be expected in the graphite and beryllium reflectors except possible weakening of the leaf springs which provide lateral core support and an unknown, but possibly damaging, effect on the control vanes. For operating times greater than about 1.5 minutes, some aluminum pressure vessel melting can be anticipated. If loss of coolant occurs immediately on shutdown, re-start capability is lost after 20 to 30 seconds depending on reactor operating time. If coolant flow is not resumed within this period, substantial damage which might well contribute to break-up of the reactor during atmospheric re-entry can be anticipated. This possibility is much greater for relatively slow shutdowns following relatively long reactor operating periods. (auth)

11060 (WANL-TNR-148(Rev.2)) SAFETY ANALYSIS REPORT, NRX TESTING. Hemmerle, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Apr 1964. 382p. Dep. NTIS $22.25.

Declassified 30 Aug 1973.

Management of the NRDS is the responsibility of the Space Nuclear Propulsion Office, Nevada Extension (SNPO-N). The Chief SNPO-N, has the responsibility of assuring that activities conducted at NRDS do not result in undue hazard to the health and safety of people either on or off NRDS. Permission to proceed with a test event is transmitted by the Chief SNPO-N, after he assures that appropriate exclusion areas are evacuated and blocked off, and that the meteorological conditions are such that neither the planned operation nor an accidental excursion would result in excessive exposure to personnel on or off NRDS. The NRDS Safety Advisory Panel, composed of recognized experts in the field of radiation, meteorology, fallout and other subjects having influence on the safety of the test at hand, advises the Chief SNPO-N. The organization which operates the NRX test, as well as the procedural controls enforced on its operations are described. The NRDS site, a study of meteorological records pertaining to it, and the population distribution and land usage around it are described briefly. The test facilities used in NRX test operations, the reactor assembly and the operations themselves (assembly, testing, and disassembly) are detailed. Next a safety evaluation of the test operations is carried out. Equipment malfunctions and procedural errors which could lead to nuclear excursions or inadvertent fission product releases are identified, and the countermeasures employed against these are described. It is concluded that no such events are likely, but that certain cases cannot be classified as completely incredible. These are: (1) an excursion during pre-power run critical testing, releasing of the order of 10^4 MW-sec., and (2) a substantial degree of release of the run inventory (3.4×10^5 MW-sec.) due to a hydrogen or drum excursion or a core melt-down following complete coolant loss. The radiological consequences of these unlikely events are explored. It is shown that the magnitude of the NRDS and the meteorological controls enforced on the choice of run times is sufficient to bring whole body gamma, inhalation, fallout, and thyroid uptake from milk doses to well below acceptable levels at inhabited locations. Similar conclusions are reached with regard to the consequences of the normal fission product release in the power run effluent. (auth)

11061 (WCAP-8258(Rev. 1)) SPRACO MODEL 1713A NOZZLE SPRAY DROP-SIZE DISTRIBUTION. Sanford, M. O. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). May 1975. 51p. Westinghouse Electric Corp., Pittsburgh, PA 15230.

The drop-size distribution model used by Radiation and Environmental Systems for the calculation or iodine removal by the containment spray system has been reviewed. It was found that a true log-normal distribution fits the experimental data better than the upper-limit log-normal distribution currently in use up to the size of the maximum observed drop. Normalizing this distribution to 100 percent at a slightly higher drop size (4000 mu m compared to the observed maximum of 3830 mu m) results in a geometric mean diameter of 280 mu m and a standard deviation of 0.7. This model results in a slightly lower iodine removal rate (exponential time

constant is 20.0 hr^{-1} compared to 22.2 hr^{-1} based on the experimental distribution, and about 23 hr^{-1} based on the current Westinghouse model). This model will be adopted as the Westinghouse standard. (auth)

11062 (WCAP-8424(Rev. 1)) EVALUATION OF LOSS OF FLOW ACCIDENTS CAUSED BY POWER SYSTEM FREQUENCY TRANSIENTS IN WESTINGHOUSE PWRs. Baldwin, M. S.; Merrian, M. M.; Schenkel, H. S.; Vandewalle, D. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). May 1975. 41p. Westinghouse Electric Corp., Pittsburgh, PA 15230.

This study was conducted to establish a generic position on system and performance requirements for loss of flow caused by electrical system frequency disturbances. Engineering analysis, computer analysis, and literature search were employed to determine a maximum credible frequency decay rate of 5 Hz/sec on a typical electrical grid. The study of frequency decay effects showed that the core of a typical present generation four-loop (3425 MWt) Westinghouse reactor is adequately protected for frequency decay rates up to 5 Hz/sec without taking credit for the reactor coolant pump power supply breaker trip, a feature which may be deleted. The recommended frequency trip setpoint is 57 Hz for plants with 12-foot, 17 x 17 fuel assembly cores, and 58.2 Hz for 12-foot, 15 x 15 fuel assembly cores. (auth)

11063 ENVIRONMENT AND NUCLEAR ENERGY. II. Environmental Radiation from Pressurized Water Reactors. Wright, J. H. Energ. Nucl. (Madrid); 18: No. 92, 417-422(1974). (In Spanish).

The radiation exposure of the general public resulting from the normal operation of one reactor and the normal operation of several reactors and the long-term exposure dose of the world population as a result of the total nuclear cycle are analyzed. In each one of these three cases the exposure standards of the Federal Radiation Council and the base design predictions of a nuclear reactor are compared with actual operational data. The consequences to the population are deduced. Data from PWR's in operation are used for these calculations. (JSR)

11064 IEEE GUIDE FOR GENERAL PRINCIPLES OF RELIABILITY ANALYSIS OF NUCLEAR POWER GENERATING STATION PROTECTION SYSTEMS. IEEE Std 352-1975. New York; Institute of Electrical and Electronics Engineers, Inc. (1975). 74p. (ICONS-01998).

Essential methods and procedures of reliability engineering for reactor protection systems are outlined. (JWR)

11065 UNCERTAINTY ANALYSIS OF THE PERFORMANCE OF COMPLEX SYSTEMS. Cox, N. D. (Univ. of Arizona, Tucson); Cermak, J. O. Energy Sources.; 1: No. 4, 339-359(1974).

Moment-matching is a rigorous statistical analysis of a linearized system performance function. Three advantages over the Monte Carlo simulation technique are: a change in input data does not necessitate any appreciable increase in required computer time; the relative importance of each random variable may be ascertained by inspection; and probabilities in the tails of the distribution of system performance are acquired. Subjectively evaluated data may be used for an initial assessment of uncertainty. In this respect, the beta distribution should become a handy tool for describing random variables, particularly those with asymmetric distributions. Furthermore, the beta distribution is a more realistic description of physical variables, because the range of the variate is limited to a finite interval. For the example analyzed (LOCA) with this technique, the probability of exceeding 2300^0F was less than 10^{-18} for the 15 x 15 and 17 x 17 fuel-rod array core configurations, when only minimum-safeguards operation was assumed. It should be noted that the probability of the LOCA occurring has not been factored into this analysis and, if it had been, the aforementioned probability would be still lower. (auth)

11066 FOUNDATION INVESTIGATION FOR NUCLEAR POWER STATIONS. Majumdar, D. K. Power Eng.; 79: No. 5, 40-41(May 1975).

Siting of a nuclear power plant encompasses the environmental and ecological aspects including meteorology, hydrology, geology, seismology, and foundations. On April 28, 1972, the Atomic Energy Commission adopted a policy to encourage, support, and give priority consideration to activities leading to greater standardization of nuclear power plants in terms of design, fabrication, construction, testing, and operation. Twenty-six items are listed for consideration for a nuclear plant. (MCW)

11067 ENVIRONMENTAL PROTECTION AND NUCLEAR POWER PLANT SITING. Guck, R. (Badenwerk A. G., Karlsruhe (F. R. Germany)). Elektrotech. Z., A; 96: No. 1, 38-44(1975). (In German).

The efforts devoted to the development and improvement of the environmental conditions have been obviously increasing during the last years and have raised conflicts between environmentalists and the energy producing industry, particularly the electricity producing companies. But electric energy has been contributing to the research of solutions to environmental problems. However, these problems cannot be expected to be solved in the future without nuclear energy. The indispensable construction of new nuclear thermal power plants requires the availability of appropriate sites. These sites have to be chosen with respect to two main factors; the impact of the power station on the environment and the requirements of the power economy. (auth)

11068 EVENTS FROM THE PRESSURE RELEASE OF A VESSEL WITH BOILING OR PRESSURIZED WATER. Ruediger, B. (Battelle-Institut e.V., Frankfurt am Main (F. R. Germany)). Dechema Monogr.; 73: No. 1410/1431, 215-227(1974). (In German).

If the pressure in a system with boiling or supercooled water is suddenly released, non-static two-phase currents (water-steam) occur which have more complex flow characteristics than do the compressible gases. For the safe arrangement of light-water cooled nuclear reactors, the fracture of a main coolant feedline and the associated pressure release are assumed to be an extremely unlikely accident. At the Battelle Institute in Frankfurt the fracture is being experimentally simulated and the fundamental thermodynamic and flow process investigated. Test results of a plant with a 11.2 high pressure tank show that in the first tenths of a second after the fracture there is a thermodynamic imbalance between the steam and water phases. The two-phase mass flows determined at the point of fracture are markedly dependent on the geometric characteristics of the pressure tank and the broken feedline. (auth)

11069 SAFETY OF A NUCLEAR POWER PLANT. Reijonen, H. (Valtion Teknillinen Tutkimuskeskus, Otaniemi, Finland). Tutkimus Tek.; No. 2, 31-40(1974). (In Finnish).

Reactor safety of gas cooled reactors (Magnox-, AGR-, and HTGR- type) as well as water or heavy water cooled reactors (BWR- and PWR-type as well as CANDU and SGHWR) is studied. The reactor risk based on the probability is treated by the aid of Farmer-curves concerning the frequency and radioactivity of reactor poison removal. The emphasis is especially attached to the most important factors of reactor safety: the heat exchanger in HTGR-type reactors and the loss of coolant in water or heavy water cooled reactors. The emergency core cooling system and its simulation is discussed. (FI)

11070 DETONATION OF FUEL COOLANT EXPLOSIONS. Board, S. J.; Hall, R. W.; Hall, R. S. (Central Electricity Generating Board, Berkeley, Eng.). Nature (London).; 254: No. 5498, 319-321(27 Mar 1975).

It is known that in certain circumstances if a hot liquid mixes with a cool vaporizable liquid, vapor production may occur at an explosive rate. Such explosions have occurred in various processes and might occur in liquid cooled nuclear reactors under accident conditions. Mechanisms are discussed and a simple one-dimensional model is presented in which the two liquids are initially coarsely mixed, with the possibility of a very violent thermal explosion occurring, analogous to a detonating chemical explosion. The model is applicable to reactors, and the destruction of the SPERT 1D reactor is quoted as an example. With regard to fast reactors it is calculated that pressures of the order of 15 k bar could be produced in large scale events involving Na and molten UO_2. (UK)

11071 NUCLEAR POWER: NEED WE HAVE DOUBTS. What Do the Technologists Think. Seip, H. M. (Oslo Univ.). Tek. Ukebl.; 122: No. 16, 19-20(10 Apr 1975). (In Norwegian).

The author was present at the panel debate and is of the opinion that the central question is not whether future generating capacity in Norway shall be based on fossil or fissile fuel, but is whether Norway should in fact increase generating capacity beyond the already planned hydroelectric schemes. Alternative energy sources, such as solar energy, were only superficially mentioned. Doubt is also expressed as to the reliability and safety of nuclear power plants. (NO)

11072 REACTOR SAFETY. A Compilation of Articles Carried in 1974 Nucleonics Week. Nucleonics Week Special Report. New York; McGraw-Hill, Inc. (1974). 23p.

News items concerning nuclear safety selected from 1974 issues of Nucleonics Week are presented. (JWR)

11073 NUCLEAR OPPOSITION. A Compilation of Articles Carried in 1974 Nucleonics Week. Nucleonics Week Special Report. New York; McGraw-Hill, Inc. (1974). 39p.

News items concerning public opposition to nuclear power and selected from 1974 issues of Nucleonics Week are presented. (JWR)

11074 PUBLIC ISSUES OF NUCLEAR POWER. Special Series of Discussions, September 23–December 4, 1974. Minneapolis; University of Minnesota (1974). 743p. $14.20.

Invited lectures by both critics and proponents of nuclear power are presented. Topics examined include reactor safety, waste management, safeguards, nuclear insurance, alternatives to nuclear power, plutonium toxicity, breeder reactor program, public hearings, licensing and regulatory functions, and energy supply and demand. (JWR)

Reactor Theory and Calculation

11075 (COO-2262-5) ANNUAL PROGRESS REPORT FY 1975. Hansen, K. F.; Henry, A. F. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Apr 1975. Contract AT(11-1)-2262. 92p. Dep. NTIS $7.75.

This project is directed toward development of numerical methods suitable for the computer solution of problems in reactor dynamics and safety. Specific areas of research include methods of integration of the time-dependent diffusion equations by finite difference and finite element methods; representation of reactor properties by various homogenization procedures; application of synthesis methods; and development of response matrix techniques. (14 references) (auth)

11076 (IAE–2338) PROGRAM FOR SOLUTION OF A KINETIC EQUATION IN CYLINDRICAL GEOMETRY. Lebedev, V. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 39p. (In Russian). Dep. NTIS (US Sales Only) $5.00.

This study presents the method and program for solving the one-velocity kinetic equation of neutron transfer in an infinite, multi-zone cylinder with the zero and first moments in the scattering index and source being taken into account under boundary conditions for a cell or reactor. The solution of the problem is carried out by the method of characteristics, in which monotonic difference schemes of high accuracy are required without limitations on the step of the network. The program can be used as a block in the calculation of multigroup problems. The program is composed for computers M-20, M-220 and BESM-4. (SJR)

11077 (LA-5885-MS) CINDER-7: AN INTERIM REPORT FOR USERS. England, T. R.; Wilczynski, R.; Whittemore, N. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1975. Contract W-7405-ENG-36. 13p. Dep. NTIS $4.00.

CINDER, a general nuclide depletion and fission-product code, has been reprogrammed to utilize improved data handling subroutines, improve roundoff control, and incorporate new calculational features such as a gamma spectra subroutine. The new coding uses a dynamic storage, variable dimensioning, and a free-form imput format. The format is not compatible with earlier versions of CINDER. The format, its bases, and some of its extended features are described. (auth)

11078 COMPARISON OF ENERGY GROUP STRUCTURES BASED ON THE MINIMUM CRITICAL MASS. Jones, R. B. Blacksburg, VA; Virginia Polytechnic Inst. and State Univ. (1975). 89p. University Microfilms Order No. 75-7558.

Thesis (Ph. D.).

Using the Goertzel reactor construct and the Goertzel-Wilkens theorem, an initial investigation is undertaken to determine guidelines on when certain multigroup problems can be satisfactorily solved with a smaller number of energy groups. This is done by varying the structure of the groups themselves. Also, two group transport and diffusion theory are compared with respect to the Goertzel construct. The minimum critical mass and the critical halfwidth are the two parameters used to contrast these results. To examine the effect of different group structures on the minimum critical mass and halfwidth, three fast groups were collapsed in all possible ways. The resultant effects on these two parameters indicate a consistent trend that either one could be used to evaluate the integrity of a group structure. In the comparison of two group transport and diffusion theory, the halfwidths are large enough to diminish the inherent error due to the omission of the transient portion of the solution in diffusion theory. Consequently, the predicted halfwidths are nearly the same. The minimum critical mass calculation, on the other hand, indicates a significant discrepancy. This parameter is found by performing the Riemann integral of the fuel distribution over the core region. It therefore incorporates any error from the halfwidth with pointwise differences in the fuel distribution. The results tentatively indicate the minimum critical mass can be used as a global parameter to assess the net accuracy of some numerical calculations. (Diss. Abstr. Int., B)

11079 SYNTHESIS OF A THREE-DIMENSIONAL NEUTRON FIELD IN CALCULATIONS OF HETEROGENEOUS REACTORS. Slesarev, I. S.; Sirotkin, A. M.; Khromov, V. V. Sov. At. Energy (Engl. Transl.); 37: No. 3, 970-972(Sep 1974).

Translated from At. Energ. (USSR); 37: No. 3, 253-254(Sep 1974).

A method for the synthesis of the neutron field in a three-dimensional heterogeneous geometry is illustrated. Results of sample calculations for a quasicritical reactor are presented. (JWR)

Reactor Components and Accessories

Refer also to abstracts 9352, 9372–9373, and 9418.

11080 (AED-CONF-74-696-002, pp 222-269) INDUSTRIAL APPLICATION OF ACOUSTIC EMISSION TESTING. Eisenblaetter, J. 1974. (In German).

From symposium of the Deutsche Gesellschaft fuer Metallkunde ueber Schallemission; Muenchen, F. R. Germany (18 Apr 1974).

With abstract.

In acoustic emission. Application in the field of experiment, testing and control of metallic materials. (Deutsche Gesellschaft fuer Metallkunde e.V., Oberursel (F. R. Germany). Arbeitsgemeinschaft Metallphysik).

Industrial applications for acoustic emission analysis techniques are discussed. Pressure vessel failure detection and weld control during fabrication are emphasized. (GE)

11081 (AED-CONF-74-696-003, pp 270-291) PRACTICAL APPLICATIONS OF ACOUSTIC EMISSION. Dunegan, H. L. 1974. (In German).

From symposium of the Deutsche Gesellschaft fuer Metallkunde ueber Schallemission; Muenchen, F. R. Germany (18 Apr 1974).

In acoustic emission. Application in the field of experiment, testing and control of metallic materials. (Deutsche Gesellschaft fuer Metallkunde e.V., Oberursel (F. R. Germany). Arbeitsgemeinschaft Metallphysik).

Acoustic emission data from three different application areas are presented: (1) Proof test monitoring of pressure vessels by use of multiple channel acoustic emission instrumentation; (2) monitoring of aircraft for fatigue crack growth and structural failure; and, (3) monitoring of the burn rate of solid propellants by acoustic emission techniques. (auth)

11082 (CONF-750617-2) COMPARISON OF TYPICAL INELASTIC ANALYSIS PREDICTIONS WITH BENCHMARK PROBLEM EXPERIMENTAL RESULTS. Clinard, J. A.; Corum, J. M.; Sartory, W. K. (Oak Ridge National Lab., Tenn. (USA)). 1975. 39p. Dep. NTIS $5.00.

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

The results of exemplary inelastic analyses for experimental benchmark problems on reactor components are presented. Consistent analytical procedures and constitutive relations were used in each of the analyses, and the material behavior data presented in the Appendix were used in all cases. Two finite-element inelastic computer programs were employed. These programs implement the analysis procedures and constitutive equations for type 304 stainless steel that are currently used in many analyses of elevated-temperature nuclear reactor system components. The analysis procedures and constitutive relations are briefly discussed, and representative analytical results are presented and compared to the test data. The results that are presented demonstrate the feasibility of performing inelastic analyses for the types of problems discussed, and they are indicative of the general level of agreement that the analyst might expect when using conventional inelastic analysis procedures. (auth)

11083 (ORNL-5019) THEORETICAL AND EXPERIMENTAL STRESS ANALYSES OF ORNL THIN-SHELL CYLINDER-TO-CYLINDER MODEL 4. Gwaltney, R. C.; Bolt, S. E.; Bryson, J. W. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 181p. Dep. NTIS $7.60.

The last in a series of four thin-shell cylinder-to-cylinder models was tested, and the experimentally determined elastic stress distributions were compared with theoretical predictions obtained from a thin-shell finite-element analysis. The models in the series are idealized thin-shell structures consisting of two circular cylindrical shells that intersect at right angles. There are no transitions, reinforcements, or fillets in the junction region. This series of model tests serves two basic purposes: (1) the experimental data provide design information directly applicable to nozzles in cylindrical vessels, and (2) the idealized models provide test results for use in developing and evaluating theo-

retical analyses applicable to nozzles in cylindrical vessels and to thin piping tees. The cylinder of model 4 had an outside diameter of 10 in., and the nozzle had an outside diameter of 1.29 in., giving a d_0/D_0 ratio of 0.129. The OD/thickness ratios were 50 and 20.2 for the cylinder and nozzle respectively. Thirteen separate loading cases were analyzed. For each loading condition one end of the cylinder was rigidly held. In addition to an internal pressure loading, three mutually perpendicular force components and three mutually perpendicular moment components were individually applied at the free end of the cylinder and at the end of the nozzle. The experimental stress distributions for each of the 13 loadings were obtained using 157 three-gage strain rosettes located on the inner and outer surfaces. Each of the 13 loading cases was also analyzed theoretically using a finite-element shell analysis developed at the University of California, Berkeley. The analysis used flat-plate elements and considered five degrees of freedom per node in the final assembled equations. The comparisons between theory and experiment show reasonably good agreement for this model. (auth)

11084 (RT/ING-(74)32) HEAT TRANSFER IN SUB-CRITICAL ONCE-THROUGH STEAM GENERATORS. Cumo, M.; Farello, G. E.; Ferrari, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov 1974. 36p. (CONF-741161-1). Dep. NTIS (US Sales Only) $5.00.

From national heat and mass transfer symposium; Warsaw, Poland (25 Nov 1974).

Results, both theoretical and experimental, pertaining to steam generators are presented. Particularly considered are once-through steam generators, in tubular ducts, heated from subcooled water (inlet) to superheated steam (out-let). Different geometries are examined, from straight and vertical tubes, to coiled tubes and to twisted tape insertion. Geometry effects have resulted to be relevant. The heating mode has been taken into account, too. Axially uniform Joule heating effect has been put in comparison with the indirect heating by a hotter fluid. Burnout heat fluxes are higher in the second heating condition. The results of basic researches, into the constitution of two-phase mixture, in the post burnout region, are also shown. (12 references) (auth)

11085 COLD TRAP FOR LIQUID SODIUM IMPURITIES COLLECTION. Pohl, L. E. (to U.S. Atomic Energy Commission). US Patent 3,873,447. B01d35/06. 25 Mar 1975. Filed date 21 Dec 1973. 8p.

PAT-APPL-427,392.

A device for removing and storing impurities found in high temperature sodium or other liquid metal loops of nuclear reactors is described. Utilization of the crystallizer zone is increased by organizing and directing the incoming flow in such a way that the impurities accumulate progressively from the bottom toward the top. This is accomplished by segregating the flow into several controllable sections. (Official Gazette)

11086 MULTIPURPOSE SAMPLER DEVICE FOR LIQUID METAL. Nelson, P. A.; Kolba, V. M.; Holmes, J. T. (to U.S. Atomic Energy Commission). US Patent 3,872,718. G01n1/10; G01n17/00. 25 Mar 1975. Filed date 30 Oct 1973. 9p.

PAT-APPL-411,129.

A device for collecting samples or examining a flow of liquid metal is provided for use with such as a liquid-metal-cooled nuclear reactor. The sampler device includes a casing surrounded by an external heater for establishing an upper isothermal zone and a lower zone for heating the entering liquid metal. One of various inserts is suspended into the isothermal zone where it is surrounded by a shroud tube for directing liquid-metal flow from the heating zone into the top of the insert. Discharge flow from the insert gravitates through a helically wound tube in heat exchange contact with entering liquid-metal flow within the heating zone. The inserts comprise an overflow cup with upper and lower freeze seals, a filter for removing particulate matter, and a fixture for maintaining various sample materials in equilibrium with liquid-metal flow. (Official Gazette)

11087 AMERICAN BOILER AND PRESSURE VESSEL CODES. Stokes, J. W. (Kemperco S. A., Louvain (Belgium)); Mayer, K. H.; Holly, L. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A. G., Nuernberg (F. R. Germany)). VGB Kraftwerkstech.; 54: No. 12, 835-842(Dec 1974). (In German).

The B and PV Code contains the technical rules for boilers and pressure vessels as elaborated by the technical committees of the ASME. Since there are no uniform rules for technical inspection and supervision as a result of the very distinct federal structure of the United States, one or more sections of the B and PV Code have been introduced in 47 states and in 37 cities and districts. In some states there are additional amending or restricting rules. Technical inspection is the responsibility mainly of inspectors of authorized insurance companies. In addition, there are inspectors employed by federal agencies and municipal authorities. The inspectors are granted licenses after having passed an examination before a National Board. Under the latest regulations, the quality assurance program applicable only to nuclear reactor components will be extended also to all the other sections of the B and PV Code. It is one of the preconditions to a license for construction of components subject to clearance. The manufacturers of boilers and pressure vessels are granted the seal of the ASME after positive inspection, which is equivalent to a general clearance. In accordance with a court decision of late last year, this general clearance can now also be granted to non-U. S. manufacturers. (GE)

11088 STRAHLUNG UND STRAHLUNGSMESSTECHNIK IN KERNKRAFTWERKEN. (Radiation and Radiation Measuring Techniques in Nuclear Power Plants). Fischer, K. H.; Grosse-Schulte, M.; Hock, R.; Melchior, K.; Schruefer, E. (Kraftwerk Union A. G., Frankfurt am Main (F. R. Germany)); Haebler, D. von; Klar, E.; Kollmar, W.; Kuhn, L. (Kraftwerk Union A. G., Erlangen (F. R. Germany)); Schroeder, H. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Biblis (F. R. Germany). Kernkraftwerk). Berlin, F. R. Germany; Elitera (1974). 448p.

After a survey on the properties of radiation and nuclear fission the presently used radiation detectors are described. Theoretical foundations and measuring methods are emphasized more than the descriptions of single measuring devices. Special attention is paid to measuring methods for reactor power and radiation protection, and the detection of failed fuel elements is discussed. (GE)

11089 FAILURE IN STEAM TURBINE BLADES. Description of Damage and Mechanical Tests on the Steel. Vodopivec, F.; Kosec, L.; Brifah, R.; Wolf, B. (Metalurski Inst., Ljubljana (Yugoslavia)) Prakt. Metallogr.; 11: No. 12, 742-746(Dec 1974). (In English, German).

When a steam turbine was removed from service, cracks were noticed on many of the blades in the low pressure section round the stabilisation bolts and perpendicular to the blade axis. (GE)

11090 DEVICE FOR SEALING A ROTATING PLUG IN A NUCLEAR REACTOR. Brandstetter, R. (to Commissariat a l'Energie Atomique). US Patent 3,867,254. 18 Feb 1975. Priority date 17 Mar 1971, France. 4p.

The invention relates to the sealing of a rotating plug in a nuclear reactor. The sealing arrangement comprises a friction track which is formed along the periphery of the top of a ring mounted on a stationary element. An annular base coaxial with the plug is secured in sealing-tight manner to the stationary bearing around the ring and the track by means of a seal which rests on the annular base and also on the friction track of the ring and which comprises at least one friction ring and a clamping spring ring. The seal is clamped against the friction track by retractable clamping means when the plug is stationary, the retractable clamping means being carried by a ring secured to the first-mentioned ring. (Official Gazette)

11091 SUBMERGED BUOYANT JETS IN QUIESCENT FLUIDS. Chan, D. T. L. (Stone and Webster Engineering Corp., Boston); Kennedy, J. F. J. Hydraul. Div., Am. Soc. Civ. Eng.; 101: No. HY6, 733-747(Jun 1975).

Many nuclear power plants with once-through cooling systems discharge condenser cooling water into the ambient receiving water as submerged buoyant jets. Knowledge of the hydraulic behavior of these jets is necessary for optimum design of discharge structures and for predicting temperature-rise configurations. In this connection, closed-form solutions for the momentum-dominated regions of horizontally discharged round and slot jets in quiescent ambient fluids are obtained. (JWR)

Reactor Fuels

Refer also to abstracts 8604, 9338, 9342–9343, 9353–9354, 9372–9374, 9394, and 9548.

11092 (BN-7410-02) MOPS-CO1 (VC-1) EXPERIMENT. Final Report. Gaube, M.; Thomson, J. M. (Societe Belge pour l'Industrie Nucleaire, Brussels). Oct 1974. 25p. Dep. NTIS (US Sales Only) $4.25.

The MOPS-CO1 (VC-1) irradiation is an experiment sponsored by BELGONUCLEAIRE and K F A Jülich; it started with the cycle 12/70 of the BR2 reactor and ended with the cycle 03/71. The vented upper part of the capsule has been loaded with compacts of BELGONUCLEAIRE and the non vented lower part of the capsule with compacts of K F A Jülich. Irradiation performance of the coated fuel particles is analyzed. (13 references) (auth)

11093 (EUR-5009) SOFTWARE PACKAGE FOR THE CONTROL OF AUTEX. Van Montfoort, J. E.; Sorio, R. (Commission of the European Communities, Brussels (Belgium)). 1973. 34p. INIS.

The AUTEX system has been set up for the automatic evaluation of nuclear fuel burnup in reactor fuel elements by means of γ-spectrometric techniques such as γ-activity and absorption measurements. The system consists of a two dimension positioning rig, carrying the fuel element under test, and a computer-based measurement and control system. The measurement function is executed under supervision of the Hewlett–Packard 5406 B Executive Software. For the position control function, the AUTEX software package has been implemented. The hardware part of the AUTEX interface has been reported on separately. The AUTEX software can be accessed via one of the three front-end routines, which are: (1) MOVE, which performs the function of moving the rig to a pre-defined position. Provisions have been taken that a specified position is always reached from the same direction, this eliminating mechanical play. 2) MANOP and MANON by means of which the front panel functions of the AUTEX interface, mod, 119, can be disabled resp. enabled. 3) For testing purposes the MAPOS program has been added, by means of which new positions can be entered via the operator's teletype.

11094 (IAEA-166, pp 193-204) AN ANALYTICAL METHOD OF EVALUATING THE EFFECT OF ROD DISPLACEMENT ON CIRCUMFERENTIAL TEMPERATURE AND HEAT FLUX DISTRIBUTIONS: TWO AND THREE DIMENSIONAL TREATMENTS. Hishida, H. 1974.

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karlsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

An analytical method of evaluating the circumferential variations of temperature and heat flux fields inside and around a displaced fuel rod in triangular rod bundles in turbulent flow is presented with illustrative examples. The analysis mainly consists of deriving the simultaneous solutions of a set of heat conduction equations for fuel, cladding and coolant under the assumption of fully developed flow and heat transfer conditions. The local coolant velocity distribution, which is necessary for deriving the temperature field in coolant, is determined by solving the Navier Stokes equation and the turbulent mixing of coolant is taken into consideration. The results show that the circumferential variations in temperature field and heat flux field on the outer surface of cladding become more appreciable with the lower P/D ratio and with increase in fuel rod displacement. The extension of the two-dimensional method to a three-dimensional method is discussed with brief explanations on the derivation of the heat conduction equation and its solution in the form of Fourier series expansion. Some applicability of the solution is suggested. (auth)

11095 (IAEA-166, pp 205-208) EFFECT OF TEMPERATURE DEPENDENCY IN MATERIAL PROPERTIES TO HOT SPOT SUBFACTORS. Hishida, H. 1974.

From panel meeting on principles of hot-channel factor calculations for LMFBR's; Karlsruhe, F. R. Germany (22 Nov 1973).

In principles of hot-channel factor calculations for fast reactors. Summary report of a panel meeting held in Karlsruhe, 22–24 November 1973 on the recommendation of the International Working Group on Fast Reactors. (International Atomic Energy Agency, Vienna (Austria)).

Effect of the temperature dependency of pellet thermal conductivity to hot spot subfactors for the fuel center temperature is discussed. The deviation in the fuel pellet hot spot temperature due to the manufacturing tolerance in pellet characteristics results in shifting the pellet thermal conductivity range, which usually gives favorable hot spot temperature rise. Some numerical examples are given where such effects as being due to the shift in pellet conductivity range are illustrated in connection to the subfactors affecting linear heat rate and gap conductance. (auth)

11096 (NP–20419) QUALIFICATION OF WESTINGHOUSE POWDER SOURCES. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). May 1975. 25p. Westinghouse Electric Corp., Pittsburgh, PA.

A basis for qualifying fuel with respect to the Westinghouse densification model is presented. The qualification basis is founded on the observations that relative stability of fuels increases with increasing mean grain size and that stability of pores decreases with their diameter. In addition to the grain size and fine porosity criteria, the thermal resintering behavior of Westinghouse fuel is explored. Westinghouse data indicates that for fuel with certain grain sizes most densification is the result of removal of pores. These observations have been utilized to select limits of grain size and volume of fine porosity and thermal resintering which assure the adequacy of new process fuel. The controls on this process as described in WCAP-8218-P-A provide additional assurance of the continued acceptability of the fuels once the process is qualified. (auth)

11097 MEASUREMENT OF SURFACE CONTAMINATION OF FUEL ELEMENTS BY URANIUM. Melicher, Z.; Kubik, I. Bull. EGU; 79: 1-8(1974). (In Czech).

A review of the problems of surface contamination of fuel elements by natural uranium is presented. Measurements described are based on alpha particle detection from natural uranium deposited on the surface of fuel elements by a scintillation detector of special construction. The sensitivity of this experimental arrangement is 1.6×10^{-13} Ci/cm^2, with a background of 5 counts/min. (auth)

11098 METHOD OF DETERMINING THE AMOUNT OF AN ISOTOPIC MIXTURE OF NOBLE GASES PRESENT AS A TAG IN A NUCLEAR REACTOR FUEL ELEMENT. Durigon, D. D.; Deklever, R. C. (to United States Energy Research and Development Administration). US Patent 3,869,610. 4 Mar 1975. Filed date 8 Jan 1974. 4p.

A predetermined small amount of krypton-85 is added to an isotopic mixture employed as a tag to identify a failed fuel element before this mixture is inserted into the void volume of the fuel element. The exterior of the plenum is gamma scanned and the reading obtained compared with the reading obtained by gamma scanning an element of the same configuration known by destructive examination to have contained an effective amount of isotopic mixture. (Official Gazette)

Reactor Control Systems

11099 (AGC-2211) CONTROL COMPONENTS RESEARCH AND DEVELOPMENT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1962. 198p. Dep. NTIS $13.00.

Declassified 11 Sep 1973.

Phase I control-components research and development for the NERVA engine is described, with emphasis on the control-component design requirements necessary to meet the system performance requirements. Preliminary designs have been developed for the major control components. Component environmental testing (radiation, cryogenic, vibration, etc.) will be emphasized during development. Particular emphasis will be given to the development of thermal- and radiation-hardened electrical feedback controls components. (auth)

11100 (EGU-05120210) APPLIED RESEARCH OF DIGITAL CONTROL OF GAS OUTLET TEMPERATURE IN REACTOR KS-150. Karpeta, C. (Vyzkumny Ustav Energeticky, Prague (Czechoslovakia)). [nd]. 132p. (In Czech). INIS.

The optimum control theory was applied in the temperature control of the KS-150 reactor. The variations were studied of the quality of the estimation of the reactor conditions and control processes with the choice of suitable parameters of the optimum estimation. Also the problem of the optimum stochastic controller was dealt with. Some results relating to the comparison of the digital and the analog controls are reported. (INIS)

11101 (RT/FI-74-39) MODIFICATIONS IN CELL CROSS SECTIONS IN THE EPITHERMAL AND FAST ENERGY RANGE DUE TO THE PRESENCE OF Gd AS A BURNABLE POISON. Gabrielli, P. G.; Pistella, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1974. 20p. INIS.

In order to evaluate properly the power generated by the Gd poisoned pins currently used in LWR's effective cell macroscopic cross sections were calculated parametrically vs. initial Gd content and void content. The results were fitted by proper analytical formulation to be incorporated in the BURNY-BEVE code. (INIS)

11102 (WANL-TME–143) LOGARITHMIC DIODE CURVES. Orange, D. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Sep 1962. 8p. Dep. NTIS $4.00.

For use in many of the control circuits, an electronic element with logarithmic characteristics is needed to obtain a log function. A test setup was made to determine the logarithmic characteristics of various elements. A laboratory current source with a range of current from 10^{-10} amps to 10^{-3} amps was used. For the thermionic elements, DC was used on the filaments. A General Radio Company type 1230-A electrometer with an input impedance in excess of 10^{14} ohms was used to read

the voltage across the diode. Most of the available diodes deviated from the log curve at currents of 10^{-6} to 10^{-4} amperes. A continuing search is being made for additional elements with logarithmic characteristics that go to 10^{-3} amps and beyond. The thermionic elements that display good log curves must be further tested in a reactor to determine what effect a nuclear environment has on them. (auth)

11103 (WANL-TME-697) ANALYSIS OF THE ALTERNATE STARTUP SYSTEM FOR NRX REACTORS. Jones, D. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 Apr 1964. 41p. Dep. NTIS $5.25.

Declassified 12 Sep 1973.

An analog-computer study of the operation and performance of the single-range automatic startup system for the NRX reactors is described. The scheme, which was originally proposed by LASL for the KIWI tests, requires only one range of nuclear instrumentation. Thus, all lower levels of nuclear instrumentation and associated range-switching circuitry are eliminated. Reactor start-up is accomplished by programming the control drums out on a predetermined control-drum-position profile until the neutron-flux density in the reactor has risen to a preset value. Conventional feedback control is then initiated using the output from the single channel of nuclear instrumentation as the feedback signal. The main result obtained was the establishment of a correlation between the values of the parameters of the control-drum profile and the values of the parameters of the resulting reactor-power profile. This correlation is presented in the form of parametric curves which can be used to determine the required control-drum profile parameters in order to achieve a given set of power-profile parameters. (auth)

11104 (WANL-TME-2715) REACTOR CONTROLS CONCEPTS. Severson, W. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1970. 31p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

The Reactor Controls Concepts study was conducted as a re-examination of two problems studied previously, namely, the definition of a reactivity control span requirement for the control drums, and a definition of the structural support assembly (SSA) reactivity control span requirement. The recommendation was that the NERVA reactor should be designed to meet a $6 drum span and a $3 structural support assembly span for rated condition operation. The additional study was required by the effects of the design change from hot bleed to full flow cycle, the longer design life, xenon poisoning considerations with respect to restart, corrosion effects during the longer life, and changes in the startup characteristics due to the cycle change. There are certain penalties associated with core reliability if reactivity control at rated temperature is controlled by drum motion (due to effects on power distribution), so there are advantages to control at rated temperature by controlling the amount of hydrogen in the reflectors. (LTN)

11105 METHOD AND APPARATUS FOR CONTROLLING THERMAL NUCLEAR REACTORS. Power, J. L. (to U.S. Atomic Energy Commission). US Patent 3,624,241. G21c7/22. 30 Nov 1971. Filed date 10 Feb 1970. 5p.

PAT-APPL-10,162.

A power control system for a thermal nuclear reactor utilizes core tubes containing a solid sorbent, a thermal neutron absorbing material in ionic form, and a circulating aqueous solution. Control of the reactor is achieved by regulating the amount and distribution of the ionic poison retained by the solid sorbent in the core tubes. The amount of poison retained by the solid sorbent is regulated by controlling the chemical composition of the circulating solution. This regulation may be assisted by altering the chemical properties of the solid sorbent while the reactor is operating. (Official Gazette)

11106 COMPUTER CONTROL OF THE NEUTRON FLUX DISTRIBUTION IN A POWER REACTOR. Grumbach, R. Regelungstechnik; 22: No. 12, 375-382(Dec 1974). (In German).

The distribution of the neutron flux in a large nuclear reactor is subject to disturbances whose consequences must be counteracted by automatic control. To this end, a procedure was developed through which, by means of a process computer, a control law can be deduced from a model of the present process state. The model parameters are identified on-line, thus avoiding lengthy physics calculations. The practical applicability of the control procedure was demonstrated in experiments with a power reactor. (auth)

11107 CANADIAN EXPERIENCE IN DIRECT DIGITAL CONTROL OF NUCLEAR POWER STATIONS. Koekebakker, J. Power Eng.; 79: No. 5, 42-44(May 1975).

The success of direct digital control (DDC) at the four-unit Pickering nuclear power station has led to the planned installation of such a unit at the new Bruce nuclear generating station. Pickering is the first nuclear station to use on-line digital controllers. It cannot be operated for revenue without at least one computer operating for each reactor unit. DDC can run a nuclear plant reliably and enhance the operational efficiency. Further automation at CANDU will involve control functions such as primary heat transport system pressure control and control of water treatment plants. (MCW)

11108 NEW HYBRID COMPUTER METHODS FOR ANALYZING PROCESS DYNAMICS. I. Gaffal, F. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Analagensicherung). Regelungstechnik; 22: No. 10, 300-306(Oct 1974). (In German).

5 figs.; 2 tabs.; 14 refs. Part of a thesis of Gaffal, F.

The means by which analog and digital computers can be used to get fast, reliable, exact or simple codes for analysing the dynamic characteristics of processes by using hybrid methods for computing power density spectra, transfer- and coherence functions are shown. (auth)

11109 COMPUTER-CONTROLLED NUCLEAR PLANTS COMING IN 1980s. Reid, J. B.; Selmeczy, J. G. Elec. Light Power (Boston); 53: No. 5, E/G6-E/G7(26 May 1975).

By the late 1980s digital computers will perhaps be taking a more active role in the control of nuclear power plants. Microprocessors will take charge of functions such as feedwater control, control-rod direction, coordinated control of the reactor and turbine, and many of the functions now performed by plant computers. Improved plant availability and operational economics will result. New computer applications from which the authors feel that added benefits are to be obtained are listed and include remote multiplexing; improved sensor interface; generation of protection and safeguards signals; automatic testing; operator assistance; on-line control of plant processes; simulation; surveillance; parts inventory and maintenance schedules; and general records keeping. (MCW)

Nuclear Power Plant Economics

11110 (STI/DOC-10/164) STEPS TO NUCLEAR POWER. A Guidebook. (International Atomic Energy Agency, Vienna (Austria)). 1975. 106p. IAEA $7.50.

This guidebook is a general summary of the work that has to be undertaken in the preparation for and introduction of nuclear power in a country. In particular, the book gives guidance on the decisions that have to be taken and the requirements for studies, organization and trained manpower that have to be met on the path to the first nuclear power plant. The guidebook is intended for senior government officials, policy makers, economic and power planners, educationalists and economists. It assumes that the reader has relatively little knowledge of nuclear power systems or of nuclear physics but does have a general technical or management background. Nuclear power is described functionally from the point of view of an alternative energy source in power system expansion. (auth)

11111 APPRAISAL OF NUCLEAR POWER PLANT RELIABILITY. Applegren, G. H.; Beckwith, R.; Jakubowski, C. L.; Whysong, J. L.; Rossin, A. D. Power Eng.; 79: No. 5, 45-47(May 1975).

The performance of large power plants at Commonwealth Edison is evaluated. There are seven nuclear units with a total capacity of about 5500 MW(e); six of the units are 800 MW(e) in size or larger. Fossil-fired capacity totals about 10,600 MW, primarily coal-fired. There are five coal-fired units 600 MW in size or larger. All large units have been installed since 1964. It is found that the nuclear plants in the system are more economical than coal-fired plants even at capacity factors well below 65 percent; that the nuclear plants have slightly better availability than the fossil plants; and that system characteristics have a strong influence on the performance of all of the plants. A cost comparison is shown of electric power generation from nuclear, a combination of Illinois and Western coal, and Western coal plants. (MCW)

11112 URANIUM AS THE MAIN FUTURE POWER SOURCE. Mandel, H. (Technische Hochschule Aachen (F. R. Germany). Lehrstuhl fuer Reaktortechnik). Welt (Hamburg); No. 275, 11(Nov 1974). (In German).

The risk of building nuclear power plants and also that of a future bottleneck in energy supply, imports of about 60% of the primary energy, the costs of electricity generation and the overall consumption of electricity in the FRG, the contribution of the various primary energy sources, the development of electricity

generation, and the possibilities of regional district heating systems are discussed. (GE)

Reactor Licensing and Regulation

11113 (BQ-TOP-1(Rev.1)) BECHTEL QUALITY ASSURANCE PROGRAM FOR NUCLEAR POWER PLANTS. Rev. 1. Bernsen, S. A. (Bechtel Power Corp., San Francisco, Calif. (USA)). 1 May 1975. vp. Bechtel Power Corp., San Francisco, CA.

A description is given of the Bechtel Quality Assurance Program plan for use by the Bechtel Thermal Power Organization during the design, procurement and construction of nuclear power plants in accordance with requirements of the Atomic Energy Commission Regulation 10 CFR 50 Appendix B. (auth)

11114 (CPC-1) QUALITY ASSURANCE PROGRAM MANUAL FOR NUCLEAR POWER PLANTS. Volume I. Policies. Volume II. Procedures for Design and Construction. Volume III. Procedures for Operations. (Consumers Power Co., Jackson, Mich. (USA)). 19 May 1975. vp. Consumers Power Co., Jackson, MI.

A manual is presented which outlines the actions that are implemented by Consumers Power Company personnel during design, procurement, construction, fueling, testing, operation, refueling, maintenance, repair and modification of its nuclear power plants. The program complies with the quality assurance requirements contained in Appendix B of 10 CFR 50, and responds to the additional requirements and guidance contained in NRC Regulatory Guides and the ANSI series of Standards related to design, construction, and operation of nuclear power plants. (auth)

11115 (FIND-50327) FIND: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Horn, F. H.; Hendricks, P. L. (eds.). (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). May 1975. 37p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

11116 (FIND-STN-50485) FIND: STERLING POWER PROJECT, NUCLEAR UNIT No. 1. Hendricks, P. L. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). May 1975. 29p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

11117 (FIND-STN-50498) FIND: SOUTH TEXAS PROJECT, UNITS 1 AND 2. Carter, E. P. (ed.). (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). May 1975. 25p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

11118 (NP-20382) REACTOR LICENSING AND SAFETY, Program Report: Volume 1, Number 9. Ward, J. E.; Szalay, R. A. (eds.). (Atomic Industrial Forum, Inc., New York (USA)). Apr 1974. 114p. AIF $20.00; $10.00 members.

The contents are presented under the following headings: (1) licensing issues and the regulatory process, (2) technical issues in reactor licensing, (3) standardization: policy development and implementation, (4) technical perspectives on standardization options, and (5) recent developments in reactor safety. (DG)

11119 (NP-20431) EFFECTS OF STEAM UPFLOW AND SUPERHEATED WALLS ON ECC DELIVERY IN A SIMULATED MULTILOOP PWR GEOMETRY. Quarterly Progress Report, January 1, 1975–March 31, 1975. Block, J. A.; Crowley, C. J. (Creare, Inc., Hanover, N.H. (USA)). May 1975. 33p. Creare Inc., Hanover, NH.

A program is being conducted to develop analytical and empirical tools to permit the calculation of fluid and thermal processes occurring in the downcomer, lower plenum and cold legs during a postulated Loss-of-Coolant Accident in a Pressurized Water Reactor. Specifically, the timing and the rate of delivery of Emergency Core Cooling water to the lower plenum and the parameters and phenomena which govern it are being investigated. These parameters and phenomena include: wall heat transfer, reversed core steam flow, cold leg steam flow, fluid temperatures and flow rates, and geometry. To date, experiments have been conducted in a 1/15-scale planar model of a PWR downcomer with multiple simulated cold and hot legs. Experimental results obtained with countercurrent steam flow with and without superheated walls are reported. These tests reveal that the downcomer gap spacing is not the proper characteristic dimension for correlating or scaling bypass data. New dimensionless parameters are introduced which are shown to correlate data obtained with various gap spacings. These new parameters are based on the downcomer width (annulus circumference) as the characteristic dimension, although other dimensions, characteristic of the scale of the experiment, would work equally well. The experimental data reported show that higher values of countercurrent steam are required to bypass the ECC water as the water subcooling or flow rate is increased. This means that in a LOCA-like transient, bypass would tend to end earlier with high water flows and/or large subcooling of the fluid entering the annulus. Countercurrent steam flows in the presence of superheated walls prolong the delivery delay time up to the value of reversed core steam flow where complete bypass takes place. (auth)

11120 (NUREG/PRDI-75/6) POWER REACTOR DOCKET INFORMATION. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jun 1975. 140p. TIC $1.85.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Nuclear Regulatory Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by power plant name. (JWR)

11121 (RDT-E-1-18T(5-75)) CLASS 1 VALVES FOR LIQUID METAL SERVICE. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). May 1975. 47p. RSO.

This standard establishes the requirements for throttle, isolation, and check valve assemblies for liquid metal service constructed in accordance with the Class 1 requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Nuclear Power Plant Components, and special requirements that are additive or more restrictive. These valves are for applications in which the valve passes or stops the flow of liquid metal coolant in a nuclear reactor primary or secondary heat transfer system, or for other applications in which the valve is subject to severe operating conditions and where loss of function may impair the safety of the system in which the valve is installed. (auth)

11122 (REG/G-1.70,33(5-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS: INITIAL TEST PROGRAMS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). May 1975. 8p. NRC.

Guides for the format and content of information in Safety Analysis Reports concerning initial test programs are presented. (JWR)

11123 DEFINITIONS OF TERMS USED IN IEEE STANDARDS ON NUCLEAR POWER GENERATING STATIONS. IEEE Std 380-1975. New York; Institute of Electrical and Electronics Engineers, Inc. (1975). 15p. (ICONS-02005).

Terms used in current IEEE standards on nuclear power plants are defined. (JWR)

11124 RECORDS AND REPORTS FOR RESEARCH REACTORS. Hinsdale, IL; American Nuclear Society (1974). 4p. (ICONS-02008).

A standard for the records, reports, and other documentation required in the operation and management of research reactor facilities is presented. (JWR)

11125 PROPOSED AMERICAN NATIONAL STANDARD EVALUATION OF ANTICIPATED TRANSIENTS WITHOUT TRIP ON PRESSURIZED WATER REACTOR PLANTS. Hinsdale, IL; American Nuclear Society (1975). 48p. (ICONS-02003). $10.00.

A proposed standard for providing interim guidance for the preparation of evaluation reports on anticipated transients without scram in PWR's is presented. (JWR)

11126 IEEE RECOMMENDED PRACTICE FOR MAINTENANCE, TESTING, AND REPLACEMENT OF LARGE LEAD STORAGE BATTERIES FOR GENERATING STATIONS AND

SUBSTATIONS. IEEE Std 450-1975. New York; Institute of Electrical and Electronics Engineers, Inc. (1975). 12p. (ICONS-02004).

This document is limited to providing recommended practices of maintenance, test schedules, and testing procedures that can be used to optimize life and performance from large lead storage batteries. It also provides guidance to determine when batteries should be replaced. (auth)

GENERAL AND MISCELLANEOUS

Information Handling

11127 (CERN-74-9(Vol.1), pp 185-206) GUIDE TO INFORMATION SOURCES IN TECHNOLOGY. Jesse, A. 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

Selected listing of journal titles, books and conferences, all dealing with technological field of interest in high-energy physics.

In meeting on technology arising from high-energy physics, CERN, Geneva, 24–26 April, 1974, proceedings. I. Review papers. (European Organization for Nuclear Research, Geneva (Switzerland)).

The guide consists of a selected listing of journal titles, books, and conferences, all dealing with technological fields of interest in high-energy physics. It is separated into the following categories: X = General, B = Beams and radiation, C = Cryogenics and superconductivity, D = Data processing, E = Electronics, M = Magnets and electricity, P = Photography and optics (including astronomy and surveying), V = Vacuum, W = Workshop techniques and general engineering. Each of these categories is subdivided into: (1) Current awareness sources (periodicals, indexing journals, progress reports, conferences); (2) Retrospective sources (abstracting journals, bibliographies, information services); and (3) General reference sources (guides, handbooks and encyclopaedias, dictionaries and glossaries, directories, and buyer's guides). (auth)

Management

Refer also to abstracts 8614 and 9112.

11128 (CONF-750622-2) UTILIZATION OF MANPOWER IN OCCUPATIONAL HEALTH PROGRAMS. Bolton, N. E. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 6p. Dep. NTIS $4.00.

From American industrial hygiene conference; Minneapolis, Minnesota, USA (1 Jun 1975).

The impact of the Occupational Safety and Health Act of 1970 on the need for industrial hygiene personnel is discussed. Training programs for the effective utilization of individuals with diverse scientific backgrounds in industrial hygiene programs are discussed. (CH)

11129 (PAEC(A)-744(Suppl.5)) NUCLEAR ENERGY IN THE PHILIPPINES: AN ANNOTATED BIBLIOGRAPHY. (Philippine Atomic Energy Commission, Diliman, Quezon City). Dec 1974. 60p. Dep. NTIS (US Sales Only) $6.00.

One hundred and twelve entries, primarily research reports from the Philippine Atomic Energy Commission, are compiled in the areas of chemistry, geology and mineralogy, health physics, instrumentation, isotopes and radiation, life sciences, physics, reactor technology, and general and miscellaneous. Abstracts are provided for each entry. An author index is included. (JSR)

11130 TAETIGKEITSBERICHT 1971/72. (Activity Report 1971/72). Giessen, F. R. Germany; Lenz (1972). 276p. (In German).

A brief report is given on the various working groups. (GE)

Mathematics and Computers

Refer also to abstract 9266.

Miscellaneous

Refer also to abstract 11136.

11131 (INIS-mf-1480) SHORT HISTORIC SUMMARY OF THE NATIONAL ATOMIC ENERGY COMMISSION, ARGENTINA. Alegria, J. L.; Coll, J. A.; Suter, T. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). [nd]. 14p. [In Spanish). INIS.

From 2nd Argentine congress of science history; Buenos Aires, Argentina (Nov 1972).

The world situation with respect to nuclear energy up to the end of the 1940's and its repercussions in Argentina leading to the creation of the Comision Nacional de Energia Atomica in May 1950 were analyzed. The juridic precedents justifying its creation were given. The laws and decrees contituting the legal corpus of the present CNEA are discussed in detail. The formation of the scientific and technical groups and the development of projects and installations which form the present structure of the institution are studied. The principal results obtained are cited. The authorities controlling the organization up to 1950 are discussed. 1950 can be considered a decisive year in the history of nuclear energy in Argentina. The future objectives which national policy has given to the CNEA are summarized. (tr-auth)

11132 KERNENERGIE. Begriffe, Hinweise, Tabellen. (Nuclear Energy. Definition, References, Tables). Koelzer, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). Karlsruhe, F. R. Germany; GfK, Schule fuer Kerntechnik (1973). 177p.

The compilation consists of concepts, references and tables in the field of nuclear energy and is a considerable expansion in topic as well as in scope of the 'specialist terms in nuclear physics and nuclear technology' which were first published in 1969 and appeared in a third supplemented edition in 1971. (GE)

Life Sciences

11133 BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. Section 2. Contamination and Decontamination of Foods. No. 14. Fischer, E. (comp.). Leopoldshafen, F. R. Germany; ZAED (Nov 1974). vp.

The bibliography covers journal articles, conference lectures, reports and other types of literature. Documents of the period 1971–1973 are primarily covered. In addition, there is a detailed index, which is divided according to conference place, data, report number, authors and corporations. There is also a subject index. In order to simplify the use, the bibliographical part is arranged according to the subjects given in the index. The content of the individual references are reproduced by a series of index terms. (GE)

Physics and Engineering

11134 (ITF-74-160P) EFFICIENCY OF LUMINESCENCE DAMPING IN PARTICLE COLLISIONS IN LIQUID MEDIA. Burstein, A. I.; Naberukhin, Yu. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 27p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The formula of estimating the efficiency of impurity damping of excited molecules in liquid solutions is improved. The formula allows an experiment to be consistently described in terms of mutual approach of particles under diffusion. The probability of damping in the interaction zone calculated from experimental data using this formula enables one to reveal an anomalous increase in damping with accelerating diffusion. A microscopic interpretation of the deactivation mechanism is proposed which relates the above anomaly to the removal of energy sink saturation due to a short-lived particle contact. (auth)

11135 (ITF-74-170P) TRANSVERSE RELAXATION IN DONOR-ACCEPTOR SYSTEMS. Khomenko, Yu. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The equations of motion for the density matrix elements of a donor-acceptor pair are obtained in work on a specific model taking into account the transverse relaxation processes, the temperature influence on the effectiveness of the given processes is considered, and the role of the transverse relaxation in kinetics of the donor-acceptor excitation transfer is investigated. (auth)

11136 (ITP-74-92P) THEORY OF EXCITATION TRANSFER IN A DONOR-ACCEPTOR SYSTEMS TAKING INTO ACCOUNT REABSORPTION PROCESSES IS INVESTIGATED USING THE SIMPLEST MODEL. Serikov, A. A.; Khomenko, Yu. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 15p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The excitation transfer in the donor-acceptor systems taking into account reabsorption processes is investigated using the simplest model. Expressions for the time evolution of the donor-acceptor pair as an "open" dynamic system are obtained. Special attention is given to the reabsorption mechanism of the excitation transfer. The expression for the acceptor luminescence quantum yield of the system under consideration is obtained and analyzed. (auth)

COMPLETE OR PARTIAL COLLECTIONS OF ERDA REPORTS IN COUNTRIES OTHER THAN THE UNITED STATES

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Buenos Aires, Comisión Nacional de Energía Atómica

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Brussels, European Atomic Energy Community (Euratom)
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